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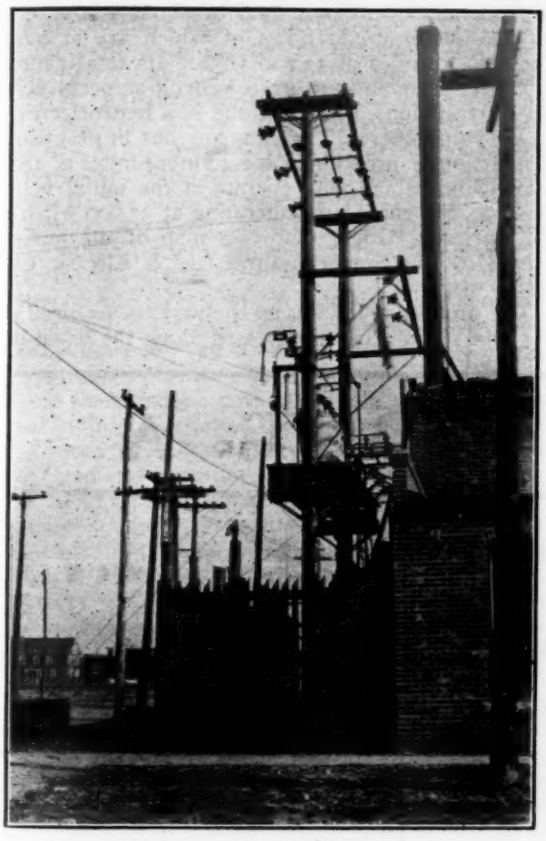


Fig. 1.—Lightning Arresters, Switches and Transformers at Eagle Grove.

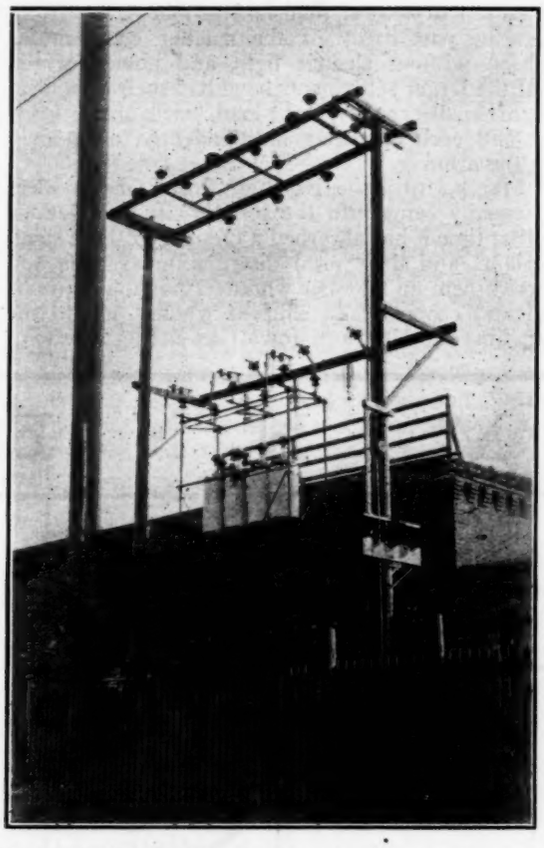


Fig. 2.—Bank of Transformers and Lightning Arresters Installed Outside Eagle Grove Station.

Linking Up Rural Communities in Iowa

Transmission Line Economics and Centralized Generation Enable Scattered Settlements to Have Electricity Supply

CO-OPERATIVE effort in the way of interconnection between central-station companies, and the linking up of various sources of energy and supply has received considerable attention and impetus since the war has imposed severe demands for economy and efficiency and the conservation of fuel, labor and apparatus. California with her large and numerous stations and abundant water power has attained a high degree of interconnection—the largest network in the world. Several other states have also progressed along similar efficient and advantageous lines. Much publicity has been given the methods of linking and unification of these larger systems, because of the wide territory affected, the numerous generating stations involved, their large capacity and so on. The same process has, however, been in progress upon a smaller scale, though perhaps larger proportionally, with some of the smaller companies, whose loads, systems and territories are of less magnitude than of those having received so much publicity. All the benefits that accrue to the large companies, and their customers, through interconnection and unification of systems, also accrue to the small, and perhaps to even larger extent in comparison than with the larger. However, these small companies have not received the publicity that have the larger companies. They are nevertheless interesting, perhaps more so than the larger for economics have to be practiced that play a less vital part with the larger companies.

The Northern Iowa Gas & Electric is an interesting instance where a number of independent and comparatively small and therefore necessarily inefficient

electric light properties have become consolidated under one management and linked up their power plants and systems in a business-like way for the efficient and reliable generation and distribution of electrical energy.

The territory served by the Northern Iowa & Gas Electric Company comprises the central and northwestern sections of Iowa, a territory rich in agricultural undertakings, and fairly well settled by farmers and rural settlements. It is a typical rural territory, somewhat sparsely populated, where settlements of a few hundred to several thousand people have sprung up. In the past many of the smaller communities have been without electric light and power, whilst some of the larger settlements have had their own local plants, of small capacity, light load, unfavorable load-factor, and each operating independently, often only during the evening.

In March, 1916, the Northern Iowa Gas & Electric Company came into the territory it now serves. Since that time it has absorbed a number of these small local plants and their local distributing systems and connected them up together wherever possible into one unified and economically efficient whole. Up to the present time the Northern Iowa Gas & Electric Company has absorbed the following companies with stations of the capacity shown in the following table:

Name of company absorbed.	Capacity in kilovolt-amperes.
Spirit Lake Electric Light Company	400
Emmetsburg Electric Company	268
Northern Iowa Power Company of Humboldt	*1,125
Citizens' Light, Heat & Power Company	775
Clarion Light Company	250
Forest City Electric Light & Power Company	185
Sioux Rapids Electric Company	75

*Of which 500 kv.-a. is hydroelectric.

At the present time the Northern Iowa Gas & Electric Company operates a total of about 160 miles of transmission line, 120 miles of which are at 22,000 volts and 40 miles at 13,200 volts. Its total generating capacity amounts to 2750 kilovolt-amperes generated by 7 stations, of which one is a hydroelectric of 500 kilovolt-amperes. The company has in progress of construction or proposed some 40 more miles of transmission line, which may operate at the initial voltage of 22,000, but capable of operating at 33,000 when the load warrants. Fig. 3 shows a map of the territory covered by the Northern Iowa Gas & Electric Company.

The process of linking up the various acquired systems and stations has progressed along the usual lines

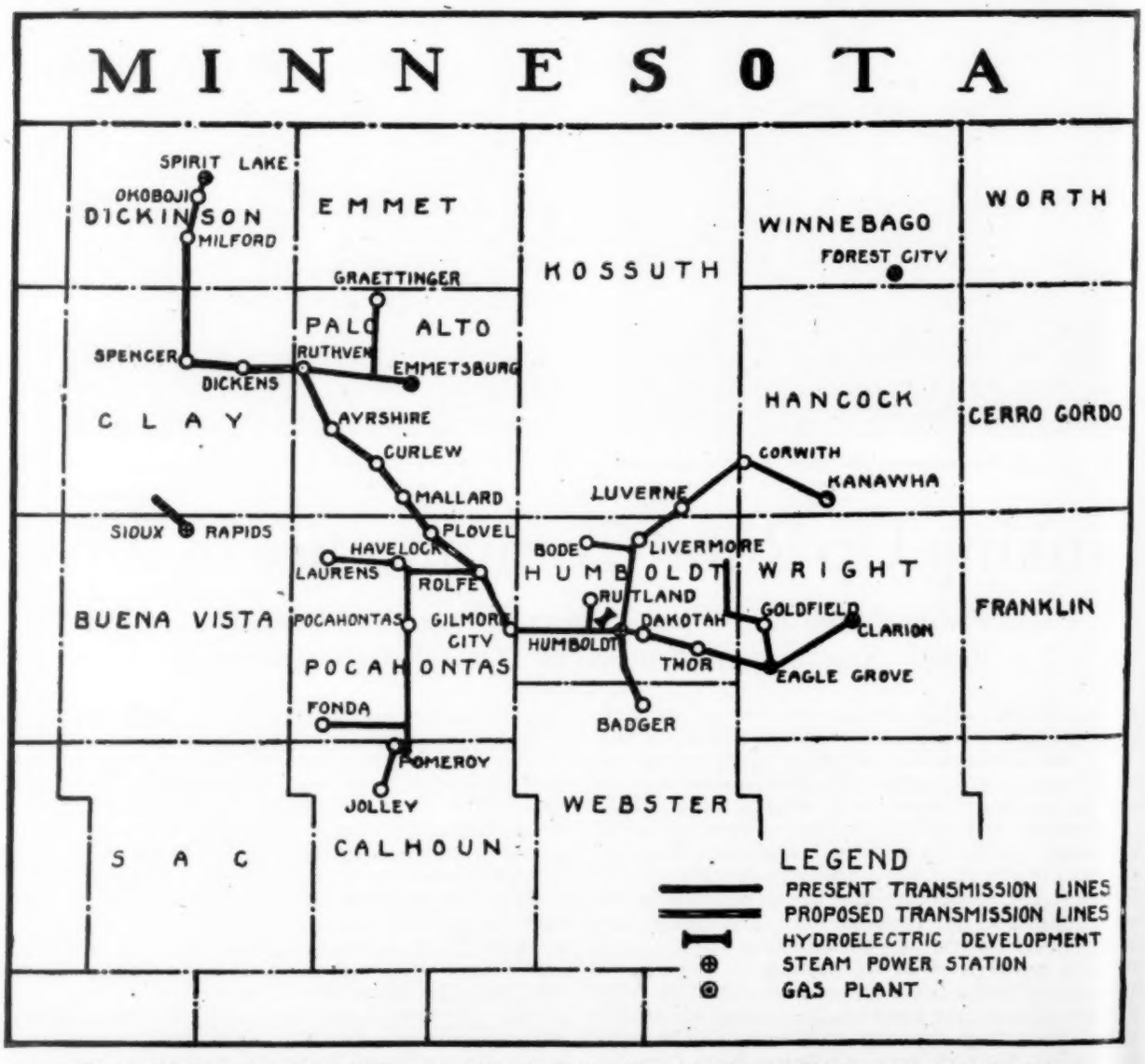


Fig. 3.—Territory Served by Northern Iowa Gas & Electric Company, Showing Existing and Proposed Lines.

as the territory served by the various systems approached each other. In this way parallel operation of the stations at Humboldt, Eagle Grove and Clarion became possible, an arrangement that permits shutting down any of the stations when desirable, for the improvement of operating economy and higher load-factor of the remaining station or stations, or as necessary for repairs. In the natural order of things the system will continue to grow, expand and enlarge as the loads grow and demands for service increase until within the next few years the present towns connected will probably all be tied in together.

At present, as illustrated by the map, four power houses, Spirit Lake, Sioux Rapids, Forest City, Emmetsburgh, remain isolated from the main centrally located system. Spirit Lake will eventually connect up with Emmetsburg, and this whole section will in turn tie in with the central transmission network supplied by Humboldt and Eagle Grove when the 35-mile transmission line is completed between Rolfe and Ruthven. For the present Sioux Rapids and Forest City are to remain isolated.

One of the interesting features of the Northern Iowa Gas & Electric Company's transmission and generation systems is the smallness of the system compared to many interconnected systems. The connected load and the territory covered is also surprisingly increased by interconnection of the various power plants as compared to conditions existing when each plant was isolated and operating independently of any other. The total generating capacity amounts to 2750 kilovolt-amperes, the largest station contains 1000 kilovolt-amperes, the smallest 185 kilovolt-amperes. However, as conditions permit, in fact as is now being done, the smaller stations will be eliminated except as reserve capacity and for stand-by service.

Effect of Interconnection.

The financial gain by having the control of energy, fuel consumption, load and growth of load and territory under one management instead of under many, means effective effort and co-operative, sound development that reacts to the benefit of the community eventually in the way of service instead of no service at all, better and all-day service and eventually lower rates and general advantage to the community. Perhaps this may be better appreciated when it is pointed out that before the Northern Iowa Gas & Electric Company absorbed the smaller isolated plants and spread out its transmission lines many communities were without electric supply whatsoever. While the company has only been in existence two years the progress made during the last year indicates that reliable service and the benefits of electrical supply are appreciated. During the last year the output of energy increased 20 per cent. A comparison of customers in towns served by the company at retail shows that where 4131 were served in 1917 today more than 5042 are connected up. Besides this, the wholesale towns have 2100 metered customers, making a total of about 7142 customers connected up. The day load is being encouraged and courted. Current-consuming devices are being sold and readily taken up.

The benefits of connecting up the individual generating stations will be obvious by referring to the load curves shown in Figs. 4 and 5. By operating Eagle Grove and Humboldt in parallel, that is the 775-kilovolt-ampere generating capacity at Eagle Grove with the 1125-kilovolt-amperes capacity at Humboldt, of which 500 kilovolt-amperes is hydroelectric energy, it is possible to manipulate the output of the various units for maximum usage of water-power and conservation of fuel and equipment. The load curve at Eagle Grove shown in Fig. 4 indicates the steadiness of the load at this station, the load-factor being in fact about 64 per cent in the

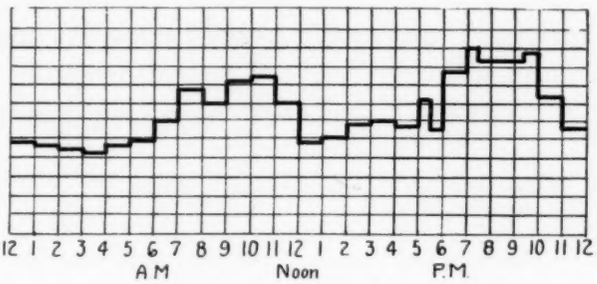


Fig. 4.—Load Curve of Eagle Grove Station.

curve shown, and sometimes being even higher. Comparison of the load curve of Spring Lake, Fig. 5, with that of Eagle Grove shows immediately the effect of interconnection between two stations. The load curve of Spirit Lake is the load curve of the community it serves, and thus does not receive the benefit of the diversity and flexibility of load change and apparatus manipulation that is possible when two stations are interconnected and serve a number of interconnected territories.

Transformer Installations.

Energy is generated at the various power houses at 2300 volts and there stepped up to 13,200, 22,000 and 33,000 volts as the case may be. The three-phase

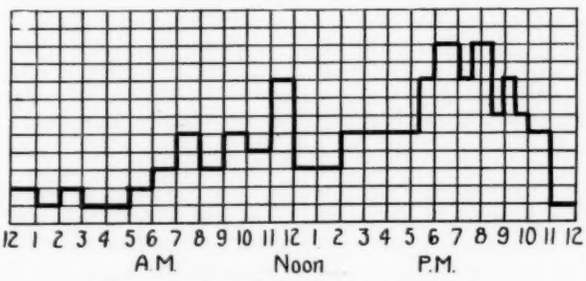


Fig. 5.—Load Curve of Spirit Lake Station.

transformer capacity at the various power houses for this purpose is as follows:

Location of power house.	Transformer capacity in kilovolt-amperes.
Eagle Grove	600
Humboldt	875
Clarion	150
Emmetsburg	75
Spirit Lake	150

The accompanying table gives the transformer capacity of the more important transformer stations along the transmission line, and the approximate population of the community served, based largely upon the last census.

The majority of transformers are installed outdoors, although there are a few brick substations. Where a power load is considerable, transformers are connected in delta-delta. However, in some of the cases where the three-phase power is comparatively small only two transformers connected in open-delta

are used. In a few instances single-phase energy is supplied, as at Thor and Rutland.

Name of transformer station.	Capacity of transformers in kilovolt-amperes.	Population of settlement.
Thor	20	...
Kanawha	40	...
Cowith	50	455
Luverne	40	501
Livermore	40	630
Bode	30	419
Rutland	20	...
Gilmore City	40	936
Rolfe	90	...
Havelock	20	300
Laurens	50	...
Pocohontas	100	...
Fonda	75	978
Pomeroy	75	933
Milford	30	825
Ruthven	30	...
Graettinger	45	750
Arnold's Park	90	...

The step-up transformers, or step-down when energy flows in the reverse direction, as happens when a station normally generating current for the line is shut down, at both Eagle Grove and Humboldt are installed outdoors. An understanding of the arrangement may be obtained by Fig. 2, which shows the lightning arresters and one set of three 150 kilovolt-ampere transformers installed outside the power house at Eagle Grove. The arrangement at Humboldt is somewhat different from that at Eagle Grove on account of the fact that it is necessary to be able to isolate Humboldt without interrupting Eagle Grove from continuity with the north and west lines to Gilmore, Livermore, and so on. The transformers at this station are in two banks with a total capacity of 875 kilovolt-amperes with two sets of Westinghouse electrolytic arresters.

Line Construction.

The line construction has from the first aimed at two things, absolute reliability and low unit cost. These two are usually considered as being antagonistic, but by the application of sound engineering practice, application of original ideas and first-class workmanship throughout both have been attained. The small amounts of energy to be transmitted, relatively speaking, has enabled a light but rugged form of construction to be employed. In the majority of cases transmission line conductors have been chosen with regard to mechanical strength rather than electrical conductivity. As the load requirements demand the capacity of all circuits can be increased by increasing the present voltage from 13,200 and 22,000, as the case may be, to 33,000 volts. Portions of the 22,000-volt line already have insulators adapted to 33,000-volt service, the voltage for which the outdoor substations have been originally designed. Conductor spacings have also been chosen with this end in view.

Wooden poles are used throughout the system, the spacing varying with local conditions. A number of forms of supporting structures are likewise in vogue, depending upon the condition and topography of the ground covered, and direction of pull of conductors.

All transmission lines are single three-phase circuits. Eventually when all the lines it is proposed to construct are built, a ring system will be formed, thus making possible the supply of energy from two directions, the supply of energy to a maximum number of communities with a minimum of investment, at the same time rendering the greatest reliability of service and flexibility of operation. The arrangement of conductors varies with conditions. In some instances all three conductors are placed in a horizontal plane on the same cross arm, in other cases in a triangle upon two cross arms.

A Siemen's-Martin steel stranded galvanized cable supported on metallic extension to the pole by clamps is carried above the transmission lines. This line is grounded at each pole.

The line insulators are of porcelain, and are carried by malleable-iron wood-top pins with steel bolt. For the newer 22,000-volt and 33,000-volt lines all metal pins will be used.

A telephone line is carried on the same pole as the circuit. This line consists of No. 10 iron wire supported on porcelain insulators, transposed every fifth pole.

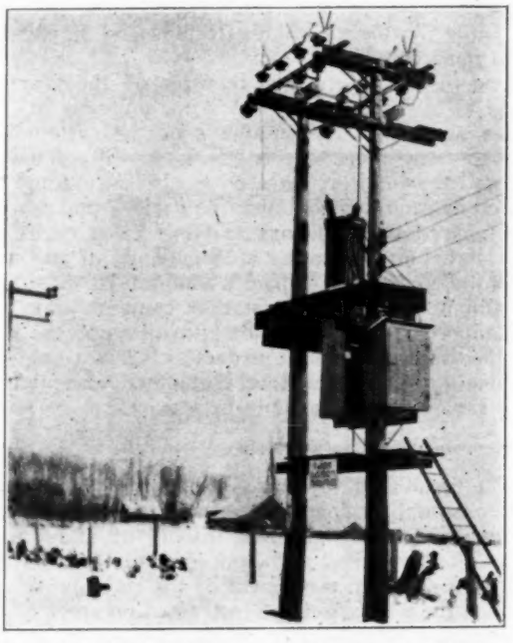


Fig. 6.—Delta-Star Substation at Thor, Showing Metering and Telephone Houses.

All generating stations are equipped with telephone outfits, and a large majority of the outdoor substations. One such installation, consisting of power transformers, telephone booth and metering and control house is illustrated in Fig. 6.

The Northern Iowa Gas & Electric Company is controlled and operated by the Union Utilities Company, Chicago, which also owns the Dubuque Electric Company of Dubuque, Iowa, the Vicksburg (Miss.) Light & Traction Company, and a number of gas plants in Indiana, Missouri and Michigan. The officers of the Union Utilities Co. are I. C. Elston, Jr., President; A. C. Allyn, Vice President; J. N. McCallum, Secretary-Treasurer, all of Chicago. The officers of the Northern Iowa Gas & Electric Company are I. C. Elston, President, Chicago, Ill.; D. M. Sterns, Vice President, Humboldt, Iowa; J. N. McCallum, Secretary-Treasurer, Chicago, Ill.; Clarence G. Johnson, Chief Engineer, Chicago, Ill.; and L. W. Wade, Humboldt, Iowa, Auditor and Purchasing Agent for Supply Department.

Studies in Wood, Steel and Concrete Pole-Line Costs

Comparative Costs of Northern and Western Cedar, Chestnut, Three Types of Steel, and Concrete Poles—Advantages of Preservative Treatment for Wood Poles—Detailed Factors Entering Into Pole-Line Costs

By F. L. HAUSHALTER

IT IS to the financial interest of operating telephone, telegraph, and power companies to insure maximum life of their pole lines at a minimum investment—an investment not looked upon merely as an initial one in the sense of dollars put into first cost, but one that considers future years of operation and upkeep. Poles treated with some kind of preservative compound will, of course, mean a greater initial outlay, but if the preserved pole lasts 12 years longer than it otherwise would if untreated, the annual charge per pole might very possibly be less; for if the untreated pole has a life of 12 years and the treated pole a life of 24 years, two of the untreated poles must be used where only one treated pole is used. The saving depends on the factors that go to make up the annual charges, such as initial pole cost, cost of preservative treatment, depreciation charges, interest charges on money invested, labor cost, and freight cost.

It is believed that the wood-pole problem as treated in this article is the most important because wood poles are most extensively used. The tendency to use steel poles for ordinary telephone, telegraph, and low-voltage power lines has not been very marked. Although the installation of steel and concrete poles may make possible a lower annual charge on permanent rights-of-way, yet the interest in such installations seems to be slight. This article deals with the ordinary telephone, telegraph, and low-voltage power lines, lines that are by far the most extensive. The conditions to be met are those incident to pole-line construction in cities and along country roads. The conditions assumed to be met are not those that would be found in a swampy or mountainous country, but an average condition such as would be found in Columbus, Ohio, and vicinity.

Preservative Treatment of Wood Poles.

In the comparison of the annual charges for the treated and untreated poles a preservative known as "AA" treatment in the specifications of the Western Red Cedar Association is assumed to be used on the poles. This provides for a butt treatment of the poles in hot creosote for a period of 15 minutes. The specifications can be consulted for further information as to the process.

Poles can be treated in general by three methods: the closed-tank pressure method, the open-tank method, and by application with a brush. In the first method the pole is submerged and the preservative forced into the wood by pressure. This is the best but most expensive treatment because of the cost of the apparatus required for it and because of the quantity of preservative used in it. The second method requires merely a dip of the pole in the hot creosote for a period of time. The third method requires but a brush application of the preservative in one or more coats.

It is believed that the second method is the best from the financial standpoint. The increase in life due to the first method as compared to the second method of treatment does not compensate for the extra cost involved in the pressure treatment. Tests carried on by the German government over a period of years show that the "AA" treatment adds an average life of 12 years to the pole. This figure is taken in this article as the life added to the pole by treating with the "AA" preservative in computing annual charges.

Calculation of Annual Charges.

The process of figuring annual charges can best be understood by referring to the data in Table I. The 6, 7, and 8-inch poles have their loads calculated for the same factor of safety. This is done as follows:

The weakest point of a pole is where the diameter is 1.5 times the diameter at the point where the load is applied. The maximum safe resisting moment at the weakest section is

$$M_r = T\frac{\pi (d + t\,y)^3}{32}$$

where M_r = resisting moment in pound-inches, T = safe fiber stress = 800 pounds per square inch for northern white cedar, t = taper, y = distance from load to weakest section, in inches; therefore $d + ty$ = diameter at weakest section = d_w. The bending moment equals the load times the distance from the load application to the weakest section, or

$$M_b = P\,y$$

where M_b = bending moment in pound-inches and P = load in pounds. The maximum safe bending and resisting moments are equal, or $M_b = M_r$. Therefore

$$P\,y = T\frac{\pi (d + t\,y)^3}{32}$$

or

$$T = \frac{32\,P\,y}{\pi (d + t\,y)^3}$$

Differentiating and setting equal to zero to find the point of maximum fiber stress, we get $y = d/2t$. Then, since $y = d/2t$ and $d_w = 1.5\,d$, by substituting in

$$P\,y = T\frac{\pi\, d_w^3}{32}$$

we get

$$\frac{P\,d}{2\,t} = T\frac{\pi (1.5\,d)^3}{32}$$

or

$$P = 0.662\ T \times t \times d^2.$$

Substituting $(8 + 0.288)$ for d, we get $P = 600$ pounds approximately. Substituting $(7 + 0.288)$ for

d, we get $P = 450$ pounds approximately. Substituting $(6 + 0.288$ for d, we get $P = 340$ pounds approximately, where 0.288 is the difference between the top diameter and the diameter where the load is applied, 1.5 feet from the top, since $1.5 \times 12 \times 0.016 = 0.288$, the taper being 0.016 inch per inch.

For the 8-inch top this is equivalent to figuring the following load on a telephone line: 38 steel wires are subjected to a wind of 85 miles per hour as a maximum load, equivalent to a pressure of 18 pounds per square foot of projected area. Diameter of No. 12 steel wire = 0.105 inch.

For figuring w, the load per foot of length, we have $w = d \times n \times v/12$ pounds per foot of length, where d = diameter of wire, n = number of wires, v = pounds per square foot of projected area of wire due to wind pressure. Then

$$w = \frac{0.105 \times 38 \times 18}{12} = 6 \text{ pounds per foot.}$$

Assuming a 100-foot span, $W = 600$ pounds load on the pole. This load is used in finding the resisting moment at the ground line. The diameter at the ground line for the 8-inch top pole is found by multiplying the taper per inch by the distance to the ground line in inches and then adding to it the 8 inches. This is referred to in the calculations as $8 + tx$, where t is the taper per inch (0.016 for northern cedar) and x is the distance to the ground line from the top of the pole. The circumference of the pole to resist decay at the ground line is then known. The weakest point in a pole is where the diameter is 1.5 times the top diameter. For the poles above 25 feet in height this point is above the ground line, but after decay starts in this point is at the ground line.

It is assumed that the pole becomes useless and its life as a pole is ended when the pole has had its ground-line circumference so reduced that its factor of safety has been reduced to one-half its former value. The diameter of the pole at such a point is found by applying the section-modulus formula as though the pole were a cantilever with the load applied at the end. The load is taken as applied 1.5 feet from the top, so that the external moment is

$$M = (L - D - 1.5)\ 12\ W \text{ inch-pounds}$$

where s = fiber stress of the wood, I/v = section pole in the ground in feet, W = load figured for the pole to carry, M = moment in inch-pounds.

Since $s = M\,v/I$

where L = length of pole in feet, D = depth of modulus = $d^3/32$ for a circle, then

$$d = \sqrt[3]{M/0.098\,s}$$

where $s = 1600$ pounds per square inch for northern cedar and 3200 pounds per square inch for western cedar, giving a factor of safety of 2.5.

The circumference corresponding to this reduced diameter is then known so that the reduction in circumference of the pole at the ground line in order for the pole to become useless as a serviceable pole is found by subtracting this value from the original ground-line circumference.

In the *Proceedings* of the American Institute of Electrical Engineers for October, 1915, will be found a paper by Rhodes and Hosford dealing with the preservative treatment of poles. They give a chart of tests conducted on the Savannah-Meldrin pole line which shows the decrease in ground-line circumference for different years of service in the case of treated and untreated chestnut poles. It is a fact that the decay of chestnut and cedar poles takes place with nearly the same rapidity. This chart is used to obtain the number of years an untreated pole may remain in service before its circumference is reduced to that as figured above for a circumference with one-half the initial factor of safety. The years of pole life are thereby obtained and this value is used as a basis for figuring annual charges.

The costs of a wooden pole line in place are: the initial cost of the pole, the delivery cost and the cost of setting. The cedar poles considered here are supposed to have been purchased from the Page & Hill Company, of Minneapolis, Minn., and the pole costs include freight from that point. In taking the prices as given it must be further explained that all prices of poles, materials and labor given in this article have to deal with normal times. In view of the present war, such prices are of course very low, in many cases 100 per cent too low, but it is felt that because of the uncertainty of where even present prices may soar, that it is best to deal with prices as prevalent prior to the war.

The depreciation charge is that based on a 5 per cent sinking fund. The interest taken is 5 per cent. The annual deposit in sinking fund to redeem $1.00 in a number of years is given in the following table to cover all cases in this article.

Years to run.	Deposit per $1.00.	Years to run.	Deposit per $1.00.
6	$0.14702	15	$0.04634
7	0.12282	16	0.04227
8	0.10472	17	0.03870
9	0.09069	18	0.03554
10	0.07950	19	0.03275
11	0.07039	20	0.03024
12	0.06283	25	0.02095
13	0.05645	30	0.01505
14	0.05102	35	0.01107

The annual interest rate taken as the charge paid on the total money invested in the pole is 6 per cent. The total annual charge then is comprised of these two charges, depreciation and simple interest charges. The spans used for the wood poles are 100 and 150 feet, hence the annual charge per mile is obtained by multiplying the total annual charge per pole by 53 and 35, respectively.

The difference in taper and fiber stress between western and northern cedar make it necessary to figure the ground-line reduction separately so as to obtain the proper life of the pole in years of service.

According to the N. E. L. A. specifications, the taper for western cedar poles is one inch in eight feet, for northern cedar one inch in five feet. Hence with equivalent top diameters the circumference of the western cedar at the ground line is less than that of northern cedar. Tests conducted by the United States Forest Service Laboratories at Boulder, Colo., and Seattle, Wash., from 1911 to 1915 point out that the modulus of rupture for western cedar is about twice that of northern cedar, the modulus of rupture being the computed stress in the pole at the ground line at the time of failure. In these tests a pole is supported as a beam one foot from each end and the load applied 4 feet from the butt support, which is approximately the ground line for a 25-foot pole. This method of test is a very close approximation to the actual conditions, since it makes little difference whether the 5 feet of butt be held rigidly in place and the load applied at the top as in an actual pole line or whether the top and butt are supported in place and bending caused by applying force at a point corresponding to the ground line as in the test. In each case the force acting on the top of the pole is definitely known and this maximum top reaction divided by 0.098 d^3, then multiplied by 12

times the distance between the top support and the point of application of the load, in feet, gives the ultimate stress. These tests gave for the average modulus of rupture of western cedar 6885 pounds per square inch and for northern cedar 3540 pounds per square inch or just about one-half as much. This double strength does not, however, make the poles equivalent in figuring pole life from ground-line decay, even though the northern cedar has the double taper.

In finding the diameter giving double the original maximum fiber stress with the same load in order to find the circumference at the time the pole life is supposed to be ended due to the decay, we use

$$d = \sqrt[3]{M/0.098 \times s}$$

For northern cedar $s = 800$ pounds per square inch, for western cedar $s = 1600$ pounds per square inch, the factor of safety being one-half the original, with $M = 600 \times (L - D - 1.5 \times 12$ inch-pounds, L being the length over all in feet and D the depth in ground in feet.

Using these formulas for a typical case, we find that for a 35-foot, 8-inch-top cedar pole set 5.5 feet in the ground,

$M = 201{,}600$ inch-pounds,

d = final diameter, for northern cedar = 10.85 inches, and final circumference is 34.2 inches, while final diameter for western cedar = 8.64 inches and its circumference 27.2 inches. Further, assuming t = taper per inch as 0.016 for northern cedar and 0.0104 for western cedar, then $8 + (L - D) \times 12 \times t$ = original diameter at ground line, $8 + 5.66 = 13.66$ inches, ground-line diameter for northern cedar; $8 + 3.68 = 11.68$ inches, ground-line diameter for western cedar; ground-line circumference = 42.9 inches for northern cedar; circumference at ground line = 34.1 inches for western cedar; reduction in circumference for northern = $42.9 - 34.2 = 8.7$ inches; reduction in circumference for western = $3.68 - 27.2 = 9.6$ inches.

In poles above 40 feet it is seen that the life of the northern cedar is more than that of the western on account of the larger diameter at the ground line, even though the stress allowed be only one-half, while poles from 40 to 20 feet have a longer life in case of the western cedar, due to the greater strength of the western wood.

In these calculations poles from 20 to 60 feet in length and having 6, 7 and 8-inch tops are taken. It is thought that this will include all poles ordinarily used under the conditions first assumed. In the comparison of the wood pole tables it should be borne in mind that the Class "B" western cedar pole has an 8-inch top while the Class "B" northern cedar pole has a 7-inch top.

ELECTRIC FURNACES IN FRANCE.

American engineers now in France have found a great deal to interest them in the works of the Compagnie des Forges et Acieries Electriques Paul Girod and the works of the Societe Electra-Metallurgique Procedes Paul Girard, which are affiliated establishments at Ugine in Savoy. Both are equipped with Girod electric furnaces operating on hydroelectric power. The first of these plants is fitted out for making electric steel castings up to 25 tons. The six furnaces originally in operation had an aggregate charge capacity of 35 tons. Two more furnaces recently constructed, one of 2 tons, and one of 12 tons, make the aggregate charge capacity 47 tons. Each furnace can be used for making at least three heats per day and each heat requires about 6½ hours. With the six furnaces in use there was difficulty in making 3000 tons of electric steel per month, or an average of 100 tons per day, and this is now being increased about 40 per cent.

TABLE I.—COMPARATIVE COSTS OF UNTREATED CEDAR POLES, 8-INCH TOPS.

Northern White Cedar. Tops 8 inches diameter. Taper (t) taken as 0.016 inch per inch. Load applied 600 pounds 1.5 feet from top. Fiber stress (s) 800 pounds per square inch. Initial cost includes freight rate from Minneapolis, Minn., to Columbus, Ohio.

Length over all, ft., $= L$	20.	25.	30.	35.	40.	45.	50.	55.	60.
Depth in ground, ft., $= D$	4.5	4.5	5.0	5.5	6.0	6.5	6.5	7.0	7.0
Moment arm, in., $= L_1 = (L - D - 1.5) \times 12$	168	228	276	336	390	444	504	558	618
External moment in.-lbs. $= M = L_1 \times 600$	100,800	136,800	169,200	201,600	234,000	266,400	302,400	335,000	371,000
Increase in dia. at ground line $= t \times x$	3.17	3.94	4.8	5.66	6.53	7.38	8.35	9.21	10.18
Diameter at ground line $= 8 + t \times x$	11.17	11.94	12.8	13.66	14.53	15.38	16.35	17.21	18.18
Circumference at ground line, in	35.1	37.58	40.2	42.4	45.7	48.3	51.4	54.1	57.1
Diameter at ground line for ½ initial factor safety	8.63	9.54	10.23	10.85	11.4	11.91	12.42	12.88	13.3
Circumference of same	27.11	30.0	32.2	34.17	35.82	37.45	39.04	40.5	41.8
Loss in circumference at ground line allowed, in	8	7.58	8	8.73	9.88	10.85	12.36	13.6	15.3
Years of service from Hosford's curves	8.8	8.45	8.8	9.22	10.1	10.73	11.9	12.85	14.06
Initial cost cedar pole	$3.80	$4.70	$8.60	$13.30	$15.95	$19.65	$22.35	$25.10	$28.00
Labor cost per pole	1.60	1.65	2.56	3.47	4.43	4.98	5.53	6.37	7.06
Total cost per pole	5.40	6.35	11.10	16.77	20.38	24.63	27.88	31.47	35.06
Depreciation deposit per $1.00@5 per cent	0.1083	0.1147	0.1083	0.0882	0.0786	0.0729	0.0636	0.0574	0.0507
Depreciation charge	0.585	0.728	1.202	1.478	1.630	1.890	1.772	1.807	1.780
Interest charge @ 6 per cent	0.324	0.381	0.656	1.010	1.220	1.480	1.672	1.890	2.104
Total annual charge	0.909	1.109	1.858	2.488	2.850	3.370	3.444	3.697	3.884
Cost per mile of 53 poles	48.20	53.50	89.50	132.00	151.00	178.00	182.80	196.00	203.70
Cost per mile of 35 poles	31.80	38.80	65.00	87.10	99.70	118.00	120.30	129.30	136.10

TABLE I (B).

Western Red Cedar. 8-inch top. Taper (t) = 1 inch in 8 feet; s = 1600 pounds per square inch. Load 600 pounds 1.5 foot from top. Same conditions as Northern Cedar.

Length over all, ft., $= L$	20	25	30	35	40	45	50	55	60
Depth in ground, ft., $= D$	4.5	4.5	5.0	5.5	6.0	6.5	6.5	7.0	7.0
Moment arm, in., $= L_1 = (L - D - 1.5) \times 12$	168	228	276	336	390	444	504	558	618
External moment in.-lbs. $= M = L_1 \times 600$	110,800	136,800	169,200	201,800	234,000	266,400	302,400	335,000	371,000
Increase in dia. at ground line $= t \times x$	1.93	2.56	3.12	3.68	4.25	4.80	5.43	6.0	6.62
Diameter at ground line $= 8 + t \times x$	9.93	10.56	11.12	11.68	12.25	12.80	13.43	14.0	14.62
Circumference at ground line, in	31.2	33.2	35.2	36.8	38.8	40.3	42.2	44.0	46.0
Dia. at ground line for ½ initial factor safety	6.85	7.59	8.15	8.64	9.07	9.49	9.89	10.22	10.58
Circumference of same	21.54	23.8	25.6	27.17	28.5	29.8	31.8	32.15	33.28
Loss in circumf. at ground line allowed, in	9.66	9.4	9.6	9.63	10.3	10.5	10.4	11.85	12.72
Years of service from curves of Hosford	9.9	9.7	9.8	9.82	10.3	10.5	10.4	11.5	12.1
Initial cost cedar pole	$2.70	$3.20	$6.60	$10.55	$11.95	$14.70	$17.15	$19.60	$22.00
Labor cost per pole	1.60	1.65	2.50	3.47	4.43	4.98	5.53	6.37	7.06
Total cost per pole	4.30	4.85	9.10	14.02	16.38	19.68	22.68	25.97	29.06
Depreciation deposit for $1.00 @ 5 per cent	0.0806	0.0829	0.0817	0.0817	0.0768	0.0749	0.0759	0.0666	0.0622
Depreciation charge	0.346	0.402	0.734	1.172	1.258	1.471	1.72	1.728	1.806
Interest charge @ 6 per cent	0.258	0.291	0.546	0.85	0.983	1.118	1.36	1.56	1.745
Total annual charge	0.604	0.693	1.280	2.022	2.242	2.589	3.08	3.288	3.551
Cost per mile of 53 poles	32.00	36.70	67.80	107.20	128.40	137.10	163.20	174.20	188.10
Cost per mile of 35 poles	21.15	24.22	44.80	70.80	78.5	90.50	107.80	115.00	124.20

Powdered Coal for Power Plants

Methods of Overcoming Difficulties in Applying Pulverized Fuel to Ordinary Steam Boilers and Adapting Boiler to Fuel

By FREDERICK SEYMOUR

BECAUSE powdered coal may be made to burn like a gas, with a dazzling white flame and intense energy, without smoke, leaving no carbon in the ash, with flue gases approximating theoretical perfection, making easily attainable a temperature of 4000 degrees Fahrenheit almost evenly distributed throughout the combustion chamber, with no opened doors or cold draughts, without banked fires, the time required to heat a cold furnace reduced by more than half with great economy in fuel and labor and with increased capacity, all under easy control of an operative of whom no back-aching duties are required; because pulverized coal has come into almost universal use as a fuel for clinkering cement and occupies a wide field for firing metallurgical and chemical furnaces, burning lime, calcining gypsum and operating dryers; because it has steadily advanced in a great variety of fields where the requirements call for constant temperature, high or low, variable temperatures in the same operation, and a variety in the quality of the products of combustion, such as a reducing, neutral or oxidizing atmosphere; because for the dirty, disagreeable, exhausting human labor job of stoking, it substitutes a clean, agreeable, easy duty of supervision of mechanical equipment requiring short experience, simple instructions and no technical education—for these reasons and many more, it has become imperative that the use of powdered coal be extended to include the furnace of most general use, the one consuming more coal than all other industrial furnaces combined and which has no exact requirements as to temperature or quality of the products of combustion, namely, the furnace for generating steam.

In the efforts to utilize powdered coal under boilers of standard type for grate fires, it is rather surprising that little use has been made of a long and extensive line of experimental work initiated in South Africa by the Engineering Staff of the Rand Mines, Ltd., under the leadership of Anthony M. Robeson and Claude Bettington, afterwards continued at the Duane Street plant of the New York Edison Company under the direct supervision of C. S. Newcomb, and concluded at the works of Fraser & Chalmers, Ltd., in England.

From the beginning till the consummation of this work, practically every method now known of firing boilers with pulverized coal was tried out with many disappointments and discouragements, but with such a degree of ultimate success that today more steam is being generated by the method finally adopted than is being generated by all the other powdered coal installations combined. Today Bettington boilers in commercial use vary in capacity from a rating of 10,000 pounds evaporation per hour to those of 40,000 pounds evaporation per hour, and many of them have been in continuous operation for as much as five years. The matter of coal conservation, the use of low-grade fuels, increased efficiency of apparatus and fuel, and the reduction of the skill and amount of labor required for any specific purpose are all such that the above developments and accomplishments deserve careful consideration.

Some Problems in Burning Pulverized Coal.

While the principles developed may not all be applicable to all types of boilers, nevertheless there is much that is suggestive. The difficulties encountered then, as now, had to do with:

1. Maintaining prompt, continuous and steady ignition, with coal varying in quality and in moisture.
2. The destruction of the brick work under the high temperatures easily attainable with powdered coal.
3. The maintenance of a homogeneous mixture in all parts of the furnace until combustion is completed.
4. The tendency of the coarser particles of coal to fall out of the zone of combustion.
5. The handling of molten ash.

It is now common knowledge that in the successful use of pulverized coal combustion must be carried on and completed before the gases come in contact with the water-cooled tubes of the boiler. This has been accomplished with the Bettington boiler by introducing the fuel vertically upward in a brick-lined cylindrical furnace, closed at the top so that the gases are compelled to spread out mushroom fashion, and pass downward along the periphery of the cylinder, escaping at the bottom of the cylinder and thence passing upward among the tubes of a vertical boiler which surrounds the combustion chamber. The brick lining of the combustion chamber, partly encircling and in close contact with the tubes of the inner row, are made of a specially formed but inexpensive brick. The incoming fuel is, therefore, in this way enveloped by downcoming gases of very high temperature which in turn are surrounded by the brick lining, outside which are the tubes of the boiler, all enclosed in a suitable casing or setting in the manner shown in Figure 1.

In view of the proximity of the exit of the hot gases to the entry of the cold mixture of coal and air, the first result to be expected is that the point of ignition could not creep away from the tuyere, and experience has demonstrated that no matter at what speed the fuel is introduced, the point of ignition remains practically constant, the presence of moisture or ash in the coal not serving to extend this point of ignition away from the tuyere.

The next anticipated result, verified by experience with this arrangement, is that under over-load firing, the brick lining of the combustion chamber melts back toward the tubes until it becomes sufficiently thin to transmit the heat to the water with such rapidity as to prevent further melting, building up again from molten ash under moderate firing so that the lining is practically permanent. In a furnace of this type the temperature is well above the melting point of any ash and the portion of the ash that comes in contact with the lining of the furnace runs down and drips off the lower edge of the lining into the ash pit below. In falling through

the cooler atmosphere of the pit, the globules of ash take on a sufficient skin or shell to prevent them from adhering one to another; they quickly solidify and may be dumped into a car or raked out like so much gravel.

Direction of Gas Flow.

The process of combustion is carried on in an atmosphere of very high temperature, is extremely rapid, and is finished before the gases enter the tubes. As the travel of the gases in the combustion chamber is first vertically up and then vertically down, gravity has no tendency to throw the coarser particles of coal

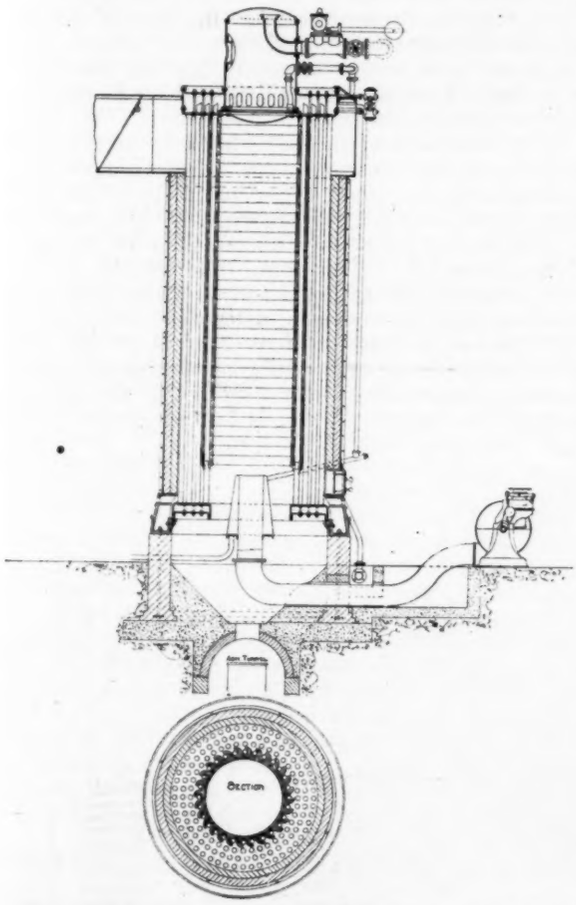


Fig. 1.—General Arrangement of Bettington Boiler for Pulverized Fuel.

out of the zone of combustion and consequently no carbon is found in the ash. The friction between the gases moving upward and the gases moving downward, the turn at the top of the combustion chamber and the friction between the gases and the walls of the combustion chamber, with the difference in specific gravity between the solid particles and the gases, all tend toward a constant re-mixture in the combustion chamber of the fuel elements and thereby expedite the process of combustion.

The following explanation may serve to make the procedure in the furnace better understood. Segregate a cubic foot of the mixtures of coal and air. It would not be far afield to estimate 1 cubic foot of air carries about one-twelfth of an ounce of coal, broken up into particles, some of which will pass a 400 mesh and nearly all of which will pass a 100 mesh, with intermediate grades. Probably 2,000,000 is a low estimate of the number of particles in the cubic foot of air, each particle of which is surrounded by the free oxygen of the air. Combustion begins, carbon dioxide (CO_2) rapidly displaces the free oxygen; the gases expand five to ten times their original volume, according to the maximum temperature of the furnace; the finer particles disappear first, the coarse survive to the last, are few in number and widely separated in a diluted atmosphere, must find free oxygen and find it instantly or be swept unconsumed among the tubes and lost. Kinetic energy and chemical affinity are working to combine the carbon and oxygen, but mechanical agitation expedites the process. Therefore all practical devices for mixing the gases in the furnace are beneficial.

Test Results.

The following abstract from test data obtained on the Bettington boiler, operating under ordinary conditions, discloses very low grade coals with high ash content. It should be of interest to note also the high moisture content, 15.6 per cent in run No. 1, combined with the high ash, total of ash and water being 38.6 per cent. The low volatile of these coals and particularly of the coal used in the third run is also worthy of notice.

DATA ON FOUR RUNS OF BETTINGTON BOILER.

Analysis of coal on dry basis.	1.	2.	3.	4.
Ash	23.00	19.92	12.64	17.89
Volatile	20.00	22.94	11.66	23.40
Fixed carbon	57.00	57.14	75.70	58.71
Value of dry coal, b. t. u.	10,700	11,988	12,276	11,109
Moisture in coal as fired	15.60	2.40	0.80	2.20
Average temperature of escaping gases, degrees Fahrenheit	592.7	603.7	560.3	.....
Pounds of water evaporated per pound of coal from and at 212° F.	8.309	9.218	9.48	9.50
Thermal efficiency based on coal	75.00	80.30	74.59	82.60

Using three of the coals shown in the abstract on grates with skilled firing under the best known water-tube boilers, even after screening and picking the coal, a thermal efficiency of only 55 per cent was obtained.

A word as to the prevailing sentiment that coal must be dried to less than 1 per cent of moisture before using it in powdered form. There are thousands of tons of coal in powdered form being used daily that are being pulverized and fed directly to the furnace, without storage and without previous drying. Where the coal can be thus handled, pre-drying becomes a question of furnace economy only, and where a supply is available, carrying less than 3 per cent of moisture, the expense of installing and operating a dryer with the necessary elevating storage and conveying apparatus cannot be shown to be economical, even if the coal occasionally comes with considerably higher moisture.

Adapting Boilers to Pulverized Fuel.

The Bettington boiler to which the above data apply is not yet made in the United States and if it were the owners of boilers of standard type would be slow to scrap them even for a much better equipment. The question then is, what can powdered coal do with the boilers that are now fired from grates; can the furnace lining be protected; can the liquid ash be easily disposed of; can the gases in the furnace be mixed as combustion progresses; can low-volatile and high-moisture coal be used? All these points have to do with the inside of the furnace and not with the preparation or handling of the coal outside.

At least one method of approaching the subject is shown in Figure 2, and applies to a boiler of the Heine

type. Modifications in detail will make it applicable to many if not all standard types.

The side walls are protected by embedded water-tubes. These tubes may well be put in a lining made of the same tile as is ordinarily used to incase the lower row of tubes in boilers of the Heine type. The front wall of the furnace is left without water-tube protection for the reason that near this wall the mixture of coal and air enters at outside temperature and the higher temperatures of the furnace are not attained until combustion has progressed almost to completion, which occurs well away from this wall. The rear wall is not protected for the reason that the tubes in the side walls and above the combustion chamber, notwithstanding that they are covered with tile, will absorb sufficient heat from the gases to bring their temperature below the destructive point before they reach the rear of the furnace.

By referring to Fig. 2 it will be noticed the grate has been removed and in its place, but at considerably lower level, is substituted a row of water-tubes upon which is laid either a covering of brick, cinders or other refractory material. Thus the combustion chamber is enclosed, except on top at the rear, with refractory material which becomes incandescent when the furnace is in operation. Combustion is carried on in an atmosphere of high temperature, well above the fusing point of any ash, progressing with great rapidity and without destruction to the brick work.

The protecting tubes are brought into the boiler circulation and their initial expense is compensated by their steam generating capacity. They also serve to reduce radiation loss. The tubes between combustion chamber and ash pit are moderate steam generators; those in the side walls are active steam generators and will evaporate more water per square foot of heating surface than the tubes of the boiler proper, for the reason that they are covered with thin refractory material, molten on the fire side but solid next the tubes and subjected to a high temperature for their full length; while the tubes of the boiler proper are affected at one end only by the high temperatures, the other end being affected by gases having only a temperature approximating that of the flue gases.

The fuel may well be introduced from either side in opposing blasts, meeting near the front of the furnace not directly head on, and each blast pointed about 5 degrees above the horizontal, in this way affecting a re-mixture of the gases after ignition with no impingement on the brick work.

The movement of the gases in two directions vertically, as in the Bettington type of boiler, is not easily accomplished in other types of boilers and with these a part of the very coarsest of the coal will be precipitated by gravity on the floor of the combustion chamber. This floor, however, is covered with a moving film of liquid ash composed principally of silica, alumina and iron, all heavier than carbon. The latter thus floats upon the surface of the liquid in contact with the atmosphere of the furnace and is consumed without loss. Analysis of this ash discloses no trace of carbon. A slot is left lengthwise in the

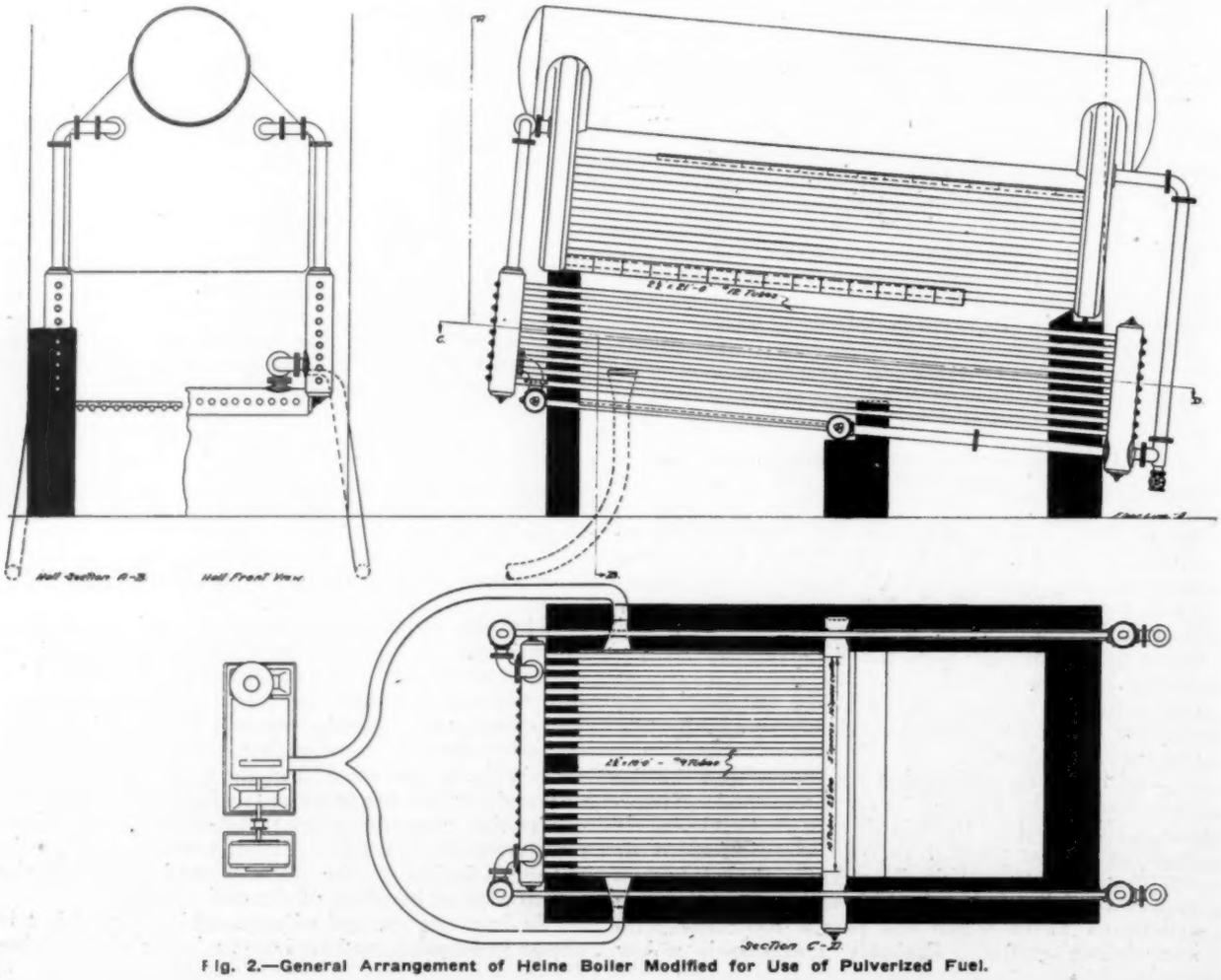


Fig. 2.—General Arrangement of Heine Boiler Modified for Use of Pulverized Fuel.

bottom of the combustion chamber. The high temperature immediately over the slot keeps it open and permits such liquid ash as collects in the furnace to drip into the ash pit below. The atmosphere of the pit, to large extent sheltered from the heat above and cooled by the water tubes over it, has a temperature far below the freezing point of the ash, and the globules in their fall from the edge of the slot to the bottom of the pit take on a skin or shell which prevents them from adhering one to another. They thus are deposited in an easily manageable condition.

The point of ignition cannot creep away from the tuyeres, because the introduction of the fuel from opposite sides of the combustion chamber at slightly different levels causes part of the flame from one blast to be driven close to the opposite tuyere mechanically. The presence of moisture and ash in the coal in reasonable percentages does not reduce the temperature or retard combustion to the prohibitive point, although, of course, neither ash nor water are desirable. The latter may be removed by the use of a dryer if present in quantities sufficient to make it economical to do so.

In the use of pulverized coal under boilers, its combustion in an atmosphere of high temperature is desirable because in such an atmosphere conditions are favorable to rapid, perfect and complete combustion before the gases reach the tubes. More steam is generated, ash collected is liquid and will flow instead of deposit in sticky, unmanageable form; precipitated carbon will float and be burned, the percentage of heat lost up the stack will be reduced, the formation of carbon monoxide (CO) under such conditions can only arise from deficient air, and the cheaper grades of coal may be used.

The generation of steam with powdered coal as a fuel has many problems of its own, the points of difficulty have not all made themselves obvious at first, and it has been necessary to persist and experiment untiringly. What remains to be done can be readily ascertained by reference to the successes and failures of others. All real obstacles are within the furnace, and, so far do not seem to defy good engineering ability. Moreover, they require only a moderate expenditure. The reward will be true and efficient fuel conservation, increased steaming capacity, greater flexibility and ease of caring for normal and peak loads, lower boiler upkeep and an end to stoker troubles.

NEW JERSEY SUPREME COURT HOLDS GOING VALUE NOT TAXABLE.

The New Jersey State Supreme Court has handed down a decision on March 22 in a case brought by the Trenton & Mercer County Traction Company for a reduction in the assessment imposed by the city of Trenton and seven neighboring municipalities, holding that "going value" cannot be properly included in appraising taxable value of the property of public utility companies. This, in the opinion of the Court, is already taxed in the form of a levy on the gross receipts of such a corporation.

Following the assessment levy by the city, the company appealed to the Mercer County Tax Board, which adjusted and reduced the valuation; later, an appeal was taken to the State Board of Assessors, which confirmed the action of the County Board in establishing the total valuation, but in so doing added to the estimate of the physical valuation the sum of $568,052, as representing the "going value."

In considering this point in its decision, and lowering the assessment by such amount ($568,052), the Supreme Court says:

"This action by the State Board seems to us arbitrary and not considered or determined with reference to the value of each assessment in each municipality. The only cases cited in justification of this method are cases dealing with property under condemnation or when the rate-making power of the state was involved.

"What is meant in the concrete by 'going value' is not made quite clear in this case. We, however, understand that the term 'going value' applied to the property of a street railroad corporation, as contrasted with the phrase 'going concern,' is that part of the value which shows the company's capacity to earn money, to make a return upon the capital invested, that in turn is primarily dependent upon its franchise, which, by the statutes, is taxed accordingly as it earns much or little, five per cent of the gross receipts. The value that is left is the value of the tangible property attached to a going concern."

TIME TO REFORM BAD PRACTICES.

Henry L. Doherty Points Out That Such Action Will Benefit Utilities More Than Increase in Rates.

Public utility managers have had many problems thrust upon them by reason of the war, and efforts have been made along various lines to offset the increased cost of production. Henry L. Doherty, at an executives' meeting at the New York office yesterday, gave it as his opinion that this was the time to reform bad practices as well as to increase rates.

Mr. Doherty thought this was the time to secure relief from such indirect taxes as paving, free service, and for the initiation of skip-stops, as well as an increase of rates. Referring to the gas business, he indicated his opinion that the installation of a readiness-to-serve rate would yield a larger income per dollar of plant investment than the present rates in force. An increase in the present flat rates would tend to reduce the gas sales, while the readiness-to-serve rate would affect only the demand and not the total consumption.

In discussing the traction situation, Mr. Doherty thought that 6 and 7-cent fares, while increasing the revenue proportionately, would have the bad effect of discouraging short distance riding. He believed that the traction situation, too, offered many opportunities for reforms that would work to a greater financial advantage than could be obtained by increased fares. The elimination of so many stops was one method he suggested. Stopping the practice of running all cars to the end of the line, reducing car mileage, was another, and, lastly, and perhaps of greater importance, was eliminating the necessity of street paving on the part of the traction companies.

Uruguayan Electrical Plants.

The Uruguayan government has approved the action of the Administration General of State Electrical Plants in declaring that of the 7,000 tons of fuel oil on hand in the deposits of the West India Oil Co., 5,000 tons be reserved for the State electrical plants, and that the latter receive the preference in the distribution of cargoes arriving hereafter. The state electrical plants burn fuel oil which is supplied under contract by the West India Oil Co., and one of the clauses of the contract provides that if at any time the supply should not suffice to meet all demands, the state plants shall enjoy preferential treatment.

LARGE ELECTROLYTIC GENERATORS FOR NORWAY.

American-made Machines Have Single Commutator for Handling 12,000 Amperes.

The increasing demand for direct current for electrolytic purposes, has led to the construction during the past few years of a number of large direct-current units.

An unusual installation is that of the Norsk Aluminum Company of Kristiania, Norway, whose new plant, located on the bay at Bergen, Norway, is now nearing completion. It is interesting to note that this hydraulic plant, with its unusually high head, is so located that the machinery can be unloaded directly from the boat to the powerhouse foundation.

The generators, which were supplied for this installation by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., are of particular interest, not only on account of the heavy current which they commutate, but due also to some unusual features of design. Three units were furnished, each having a normal rating of 3000 kilowatts, 300 volts, 300 revolutions per minute. They are water-wheel driven, the impulse turbine having a water head of 2305 feet and an overspeed capacity of 80 per cent.

Each generator is capable of a voltage variation of from 50 to 335 volts, with any current up to 12,000 amperes. Under normal rating the temperature rise does not exceed 40 degrees Centigrade on the windings and 45 degrees Centigrade on the commutator.

The most interesting feature of the design is the fact that a current of 12,000 amperes is handled by one commutator, operating at 300 revolutions per minute. The commutators are of the shrink ring construction, having the bars shrunk down solid on mica insulation, being mounted on a steel cylinder. Special provision is made to allow for equal expansion of copper and steel as the temperature of the commutator changes.

The commutators are ventilated in an interesting manner. Hollow brush brackets are used which are supported at each end by brush supporting rings, also made hollow. The brush brackets are provided with holes so spaced that a jet of air is forced radially from them in front of each brush.

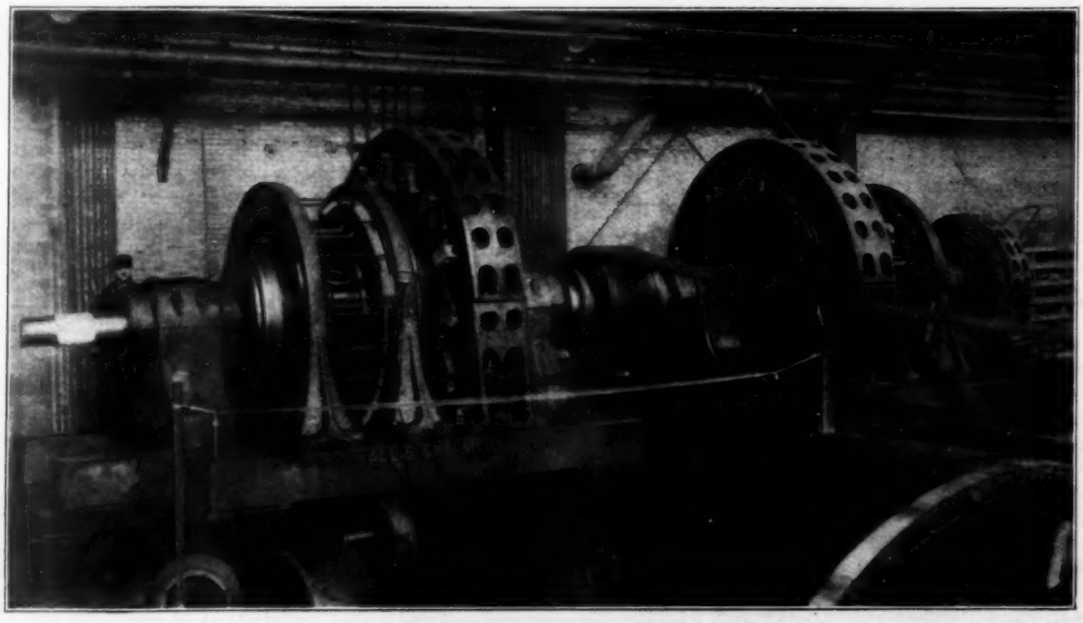
The brush supporting rings are piped to a motor-driven blower which furnishes air of the necessary volume and pressure to keep the commutator cool under all conditions. By this method of ventilation the air is delivered in the most effective manner to keep the commutator cool and also keeps it free from dirt or dust in the grooves where the mica is under cut. Furthermore, there is no interference with the shifting or adjusting of the brushes.

The machines are of the shunt-wound, interpole, compensated type, designed with a large proportion of copper and small proportion of iron in order to keep the total weight as light as possible consistent with reliable design. The armatures were made of steel throughout, special provisions being made in banding and securing the coils, on account of the high overspeed which the generators had to withstand. A 250-kilovolt-ampere, 5500-volt revolving-field alternator, mounted on the overhung shaft of one of the direct-current generators, is used to furnish power for motors around the plant.

Acceptance tests, conducted by the Electrical Testing Laboratories of New York and representatives of the Norsk Aluminum Company, showed that the machines fulfilled the contract guarantees in every particular.

AUSTRIAN ELECTRICAL DEVELOPMENT.

It has been estimated the available water powers of Austria vary between 1,700,000 and 5,000,000 horsepower. If 50 per cent were used, the annual coal savign would amount to 22,500,000 tons per annum, and Austria could then export coal to Germany instead of importing it. In a recent electrical development bill introduced in the Austrian Reichsrat it was proposed to promote the development of these water powers. One provision of the bill is that the state will participate in the profits of undertakings to which any state privileges or concessions have been granted, when the profits exceed 6 per cent.



Two 3000-Kilowatt Direct-Current Generators for Norsk Aluminum Company, Norway. Capacity of Each Is 12,000 Amperes, 300 Volts, 300 Revolutions Per Minute.

Editorial Comment

Powdered Coal

IT IS natural, and very desirable, that at a time when the fuel situation throughout the world has been subjected to upheaval, when the demands for fuel have far exceeded the ability of railroad, coal mine and oil well to meet them, that every effort be made toward the more efficient utilization of all forms of fuel in all manner of ways. The conditions created of late, and the general tendency to a better appreciation of the value of fuel, have combined to cause much attention to be devoted to the matter. Producer gas, the distillation of coals, the use of by-product gas for heat and the residues for industrial use, improvements in combustion methods and use of powdered coal, these are some of the things that have gone on.

There could be no more wasteful manner of burning coal for heat than the way usually employed, namely, the promiscuous application of coal in various sizes of lumps to an open fire supplied with varying and erratic amounts of oxygen. The method of firing and the method—too often lack of method—of controlling the chemical reaction between carbon and oxygen, are too often erratic and usually unscientific. At best the use of lump coal is clumsy and regretfully inefficient. Little comparison is there between the use of lump coal and oil and gas with their accurate and easy control, intimate mixing of fuel and oxygen, rapid chemical action, high temperatures and almost perfect combustion obtainable, all of which occur without the collection of large amounts of ash and without soot and smoke on the same scale that occurs with lump coal.

Very similar to the use of oil and gas is that of powdered coal. The coal dust suspended in air and blown into the furnace chamber is burnt rapidly at high temperatures, with little ash containing still less carbon content. Combustion or chemical action is closely and accurately regulated with ease. In fact, the predominating advantages of oil and gas firing apply to pulverized coal also.

From the academic viewpoint, powdered coal accomplishes everything in the way of high temperature, efficient combustion and accurate control and is the champion method of conserving coal by making available for efficient use grades of coal not otherwise of marketable value. In practice, however, the cost of drying, pulverizing and feeding to the furnace have acted as deterrents to its use. The large floor space required for the coal-treating equipment, storage difficulties, back-firing and burner and furnace troubles have also added their quota toward hindering the wider application of powdered fuel to steam-making boilers. But with time and ceaseless experiment many of the greater difficulties of burning pulverized coal, once thought inherent, have been overcome. Costs for pulverizing and drying have been reduced, while the degrees of dryness and pulverization once thought necessary for maintaining continual feed to the furnace and efficient combustion are now found less severe.

Today the industrial application of powdered coal to steam-making boilers is a matter of applying this powdered fuel to the boiler rather than one of overcoming inherent difficulties in treating and burning the coal. The setting of a boiler, for maximum efficient combustion, has always in part depended upon the characteristics of the coal, and unless a setting and furnace chamber were adapted for the coal used, loss and troubles due to smoke, clinker dust and inefficiency have been expected. So, too, in adapting gas and oil to a coal-fired boiler baffles, settings and stack usually require modification if excess air, waste of heat produced and utilized and imperfect combustion are not to follow. It seems only natural therefore that similar modifications must accompany the use of pulverized coal, and this surmise is borne out by an article elsewhere in this issue describing a form of boiler that differs radically from those ordinarily employed.

With the present high prices of oil and coal, the necessity of mining all coal in a seam instead of only the best of it, the imperative need for reducing the amount of coal and ash handled by the railroads and, lastly, the desirability of reducing if not entirely eliminating the smoke nuisance, with these incentives, coupled with lower fuel costs to the plant owner, powdered fuel ought eventually to come into extensive usage under steam-making boilers.

The demand exists for improved methods for burning coal over those now existent. Powdered coal may be a palliative or the solution, time will tell. Powdered coal must come into use eventually, but its coming will, however, be gradual, not sensational.

Appreciating Electric Service

WE ARE so accustomed to accepting electric service as a matter-of-fact detail in our every-day life that it seems to take unusual conditions, such as being deprived of it, to make us appreciate what it really means to us. The writer has just had an exceptional opportunity for study of this topic during an enforced vacation when he found himself flat on his back in the grasp of that well-named malady—the grip. After a spell of feverish headaches, the mind seems to react from its delerious fogs and sees facts in truer relation than when beset by the many cares of the ordinary business day.

The telephone bell emits one of the pleasantest sounds to the convalescent electrical man who realizes what service the telephone has rendered for him in summoning the physician and keeping in touch with him. To the average patient the best medical advice is given by his family physician who knows the patient's constitutional peculiarities and history. To call this physician from a distant part of the city without the telephone would be wasteful of valuable time and probably even entirely impossible. For the medical man, on the other hand, it would be very difficult to call on all his patients in different parts of a large city if the telephone did not permit him to communicate with them where a personal visit was not absolutely necessary. To the patient's family the telephone is indeed a blessing in its quick communication with the druggist and other storekeepers, besides numerous relatives and friends.

During the night the convalescent is apt to be a serious care to his worn-out family with many calls for medicine and other care. Through electric service, however, he can take care of his own needs quite comfortably. An electric lamp can be instantly turned up, a heating pad can be readily connected, as can an electric immersion heater for preparing hot gargles; all these can be easily controlled by the patient himself without disturbing the rest of his household. Such conveniences made possible by 24-hour electric service are especially appreciated by the electrical man when he himself can be their beneficiary. It is a pleasure to advocate universal electric service in the belief that it will lighten the labor of the home and make home life more cheerful, but it is a greater pleasure to see from actual experience what are the benefits of electric service at a time when one is more or less helpless without it.

If electric light, heat and telephone service can be fully appreciated by the casual invalid, they should also be more thoroughly appreciated by the well and active man. The latter can, and in many cases does, employ them on a much more extensive scale, so his benefits are proportionately greater. A modest expression of such appreciation will doubtless be gratefully received by the providers of electric service, especially at a time like the present when they are beset with many difficulties.

Year of War Shows Need for Unity of Action

A YEAR has elapsed since we were drawn into the world war. A year of momentous events, great hopes and shattered dreams. A year whose experiences should teach us most important lessons on the obligations of these critical times. What are these important lessons? A brief review of our country's part in the war should disclose some of them at least.

Righteous indignation at the violation of our national rights forced us into the war in their defense. Although woefully unprepared to take an active part in the war, a large part of the country did not regard this as a hindrance but was inclined to agree with the rhetorical assertion of a former Secretary of State that a million men would rise to arms within a day after we declared war. Alas, a year has passed and we can scarcely say we have a million men drilled, equipped and ready at the front. It was indeed a different task to bring a modern army into being from what it was conceived to be. Many reasons have made this task much more difficult than it should have been.

One of these is that the very form of our government hampers direct action. The President cannot raise an army nor declare war without the consent of the country through Congress. Congress did not know what legislation was necessary to facilitate conduct of the war. Aside from the Navy, most of the government departments were not ready to advise on desirable legislative programs to hasten their work. Our entry into the war was clearly not methodically planned and arranged, in great contrast with that of the Teutonic empires in 1914. Moreover, for a time it debated whether we should engage independent combat with Germany or join the entente allies. For many months after we came to a decision there remained a considerable element of ultra-pacifists and worse, who contended we had made a serious mistake to enter a European controversy. Exposure of seditious enemy propaganda back of this movement gradually caused it to die down, not without having done much harm to the already retarded program of preparations. Knowing no sense of shame, enemy intrigue became so unscrupulous and debasing as to arouse the country to a sense of bestial character of what was professed as kultur.

Interminable delays seemed to beset many parts of the war preparation program. The task was more gigantic than was conceived. Dissensions developed over many details of the shipping and munitions work. Frequent changes of plans were made. Controversies arose between employers and employes. The country at large went about its work but little affected by the feverish activity in Washington and certain munition centers. A violent winter with heavy snows and traffic blockades came on while a pronounced fuel shortage caused industries to be shut down. And so on.

We have blundered much during the past year. We did not know how big a task confronted us, nor the desperate character of our foe. We lacked unity of purpose until quite recently. But what we need now more than anything else is unity of action. Every American citizen must put his shoulder to the wheel to help his country in this greatest crisis in its history. Every ounce of strength is needed to back up our brave soldiers and sailors. All interests must unite, capital and labor, rich and poor. Failure would mean a greater burden on the poor than on the rich. There can be no alternative, if we cherish the hope so ably expressed by Abraham Lincoln, that government of the people, by the people, and for the people may not perish from the earth.

Week's Events

Wisconsin Utilities Discuss War Problems—Important Illumination Research by Bureau of Standards—Other News

WAR PROBLEMS DISCUSSED BY WISCONSIN UTILITIES.

Tenth Annual Convention of Wisconsin Electrical Association Pledges Loyalty to Government.

Rate problems, increasing costs, commission regulation and other similar war-time topics characterized the tenth annual convention of the Wisconsin Electrical Association, held at Milwaukee, Wis., on March 27 and 28. The sessions throughout reflected an earnest desire to maintain a high standard of efficiency, to play fair and conserve, and to devise ways of meeting the serious conditions now faced by the public utility companies. One of the salient facts in evidence was that while commercial concerns, during the last four years of rising costs, have been free to adjust product prices promptly to conform to the prevailing conditions, the public utility companies are tied down to rates and revenues based upon the costs of operating prior to the world war. Hence, the consensus of expression at this convention was that adequate revenues must be assured for operations, betterments, extensions, maintenance and, withal, a fair return on the investment. A failure to secure these requisites, in the opinion of many, would result either in a breaking down in the service so essential to the country, or in government ownership.

Another sentiment that found expression in every paper and address during the convention was for outspoken loyalty to and support of our Government in the execution of its plans for winning the war.

The convention was called to order at 10 a. m., Wednesday, by the president, B. F. Lyons, vice-president and general manager of Beloit Water, Gas & Electric Company. President Lyon reviewed the condition with which public utilities were confronted, by reason of fuel and car shortage, loss of many of its most skilled men, the mounting costs and inadequate revenue, and the necessity for increased rates of service.

After the report of the secretary-treasurer was read, an auditing committee was appointed, which reported the following day.

A. C. Babson, chairman of the Rural Service Committee, read his report on the committee's findings on that subject. This report is abstracted elsewhere.

A discussion of Mr. Babson's report followed, participated in by A. G. Fulton of Oconto, John St. John of Madison, W. H. Burk of Elkhart Lake, and others. The discussion related to extensions to serve rural districts and rates of service. The convention voted to continue this committee in service.

C. D. Se Cheverell, chairman of the Committee on Taxation, read his report, reviewing legislation on public utility taxation, and showing discriminations unfavorable to utility companies as compared with taxation of other interests.

The resignations of F. C. Ludden, Mineral Point, as third vice-president, and of George Allison, Milwaukee, as secretary, were accepted by reason of their having entered military service.

WEDNESDAY AFTERNOON'S SESSION.

Edwin S. Mack, attorney, Milwaukee, addressed the convention on "Some Phases of Depreciation in Connection With Public Utility Rate-Making." He brought up the subject of rate-making as an ever-present problem and one which affects the life and success of the utility concern. He discussed valuation for rate-making, and said under existing methods of Public Service Commissions they reduce the valuation each year by deducting for depreciation; but, in his opinion, a better method was to leave the amount of the investment unimpaired, and set up a reserve fund to provide for a replacement to make good the depreciation. He questioned the sufficiency of life tables, based on age and wear, in arriving at depreciation data, as statistics were not fully developed. For these reasons he thought valuations should not be based upon life tables. Provision should not only be made for age and wear, but for obsolescence and inadequacy to meet public requirements. His address brought forth considerable discussion.

W. J. Hagenah, of Chicago, formerly of the Public Utility Commission of Wisconsin, gave an able address on utility plant valuations, public regulation, rate-making, output costs of power and kindred matters. He went into an analysis of high labor and material costs through different war crises within the last century and the lower costs following each historic period. Present war conditions were referred to in this connection. Regulation of public utilities by commissions called for a constant adaptation to changing conditions. He urged close co-operation with the Public Service Commissions, saying the utility concerns faced the crisis of their lives.

W. N. Fitzgerald, state fuel administrator for Wisconsin, presented the coal situation in clear outline in relation to production, distribution and price. The coal shortage of the last six to eight months was ascribed to increased demand, insufficient number of cars and shortage of labor at the mines. He forecasted for the next year a demand that would exceed production, and the only way this situation could be met was by conserving and saving. High wages in war industries had taken many miners away from the coal mines, and the car-building speed was not equal to the demands for more cars. The Federal Government's zone system of moving coal to all points was in effect, and this would facilitate the delivery of coal to all zones and economize the use of cars.

The next paper was by Harold L. Geisse, secretary of Wisconsin Railroad Commission. He gave valuable suggestions on "The Presentation of a Case Before a Public Service Commission." The simplification and proper array of facts, he showed, would enable commissions to dispose of cases much more promptly.

The banquet held Wednesday evening in the Fern Room of Hotel Pfister was attended by about 300 per-

son, many ladies being present. Included in this assemblage were many members of the State Gas Association, whose convention was held at Milwaukee on March 26 and 27.

The toastmaster was Herbert N. Laflin, Milwaukee. The speech-making was interspersed with patriotic songs and instrumental music. Captain Rogers, of the army hospital corps, explained field hospitals, evacuation and base hospitals, and in that connection described the Milwaukee Base Hospital for putting men in training for actual army service. The principal address of the evening was by Lawrence A. Olwell, Milwaukee, who showed that the existing world war, as well as other wars in history, was a conflict between ideals—the ideals of freedom and democracy on the one side and the assumed divine right of kings on the other. His address was pointed and eloquent.

Thursday's Sessions.

Public Utilities and the War was the subject of a timely and able paper by M. C. Ewing, secretary-treasurer of the Wisconsin Valley Electric Company, Wausau, Wis.

Dean Treat, manager of Wisconsin Railway, Light & Power Company, La Crosse, presented a paper on Metal Electrode Welding, which received close attention and brought forth considerable discussion. The remarks by A. J. Goedjen, of Green Bay, on his experience in track welding was especially interesting. John St. John, Madison, discussed the matter of maintenance of joints made by electrode welding. William C. Lounsbury, general superintendent of Superior Water, Light & Power Company, Superior, had used this system with good results.

J. P. Pulliam read a paper prepared by Raymond C. Smith, dealing with revenues derived from electric railway service. He recommended the adoption of one-man-operated cars, which would require cars especially constructed for such a system.

A resolution, presented by C. A. Se Cheverell, chairman of the committee on resolutions, pledged this association's unqualified loyalty, and support of the United States Government in the nation's defense.

Election of Officers.

The nominating committee, in submitting its report, presented the following as officers of the association for the ensuing year:

President, John St. John, Madison.
First vice-president, Raymond C. Smith.
Second vice-president, Wm. Lounsbury.
Third vice-president, A. C. Babson.
Secretary-treasurer, J. P. Pulliam.

On motion, the report of the nominating committee was unanimously adopted and the nominees were declared elected.

L. W. Burch, Madison, appeared before the association in behalf of the Wisconsin State Association of Electrical Contractor-Dealers, and in a paper read explained the purposes and scope of the organization, as now constituted under the Goodwin plan. He assured the electrical delegates that the contractors and dealers were desirous of co-operating with the central stations in their various departments.

Closing Session.

The first paper on Thursday afternoon was presented by George E. Wagner, plant superintendent of Madison Gas & Electric Company, on "Three-phase Four-wire Distribution." His paper dealt with the subject comprehensively, and his explanations were elucidated by numerous sketches thrown upon a screen.

The closing address was by Daniel W. Mead, of Mead & Seastone, consulting engineers, Madison. His subject was "Increasing the Efficiency of Hydro-electric Plants." Mr. Mead's address, which was supplemented by numerous slides, received the closest attention from the large number of members and visitors present. The sketches thrown on the screen consisted of curves showing water-wheel efficiencies developed at many plants, graphic illustrations showing the seasonal variations in the volume of a number of streams, and exterior and interior views of plants. The problems of increasing the efficiency of hydroelectric plants, as brought out in his address, are involved in many phases of plant design and equipment, special stress being laid on demonstrated efficiency of water wheels. These phases were discussed with reference to the available water supply in each case, the adjustment of the load to the supply of water, and the waste due to leakage of dams. The graphic sketches showed the seasonal variations of power produced by Wisconsin river and numerous other streams. In this there was shown to be a wide difference in the variations of the streams considered. Much attention was given to methods of testing the efficiency of wheels and some criticism was given. However, he observed that in the last few years manufacturers had made marked progress in developing water-wheel efficiency. In conclusion, Mr. Mead strongly emphasized the necessity of greater hydroelectric developments to meet the great demands for power and to conserve fuel supplies.

All members and visitors attended a luncheon Thursday under the auspices of Electric League of Milwaukee, to hear an address by Dean William Baum of the School of Engineering of Milwaukee. Dean Baum made a plea for co-operation by industrial managers with engineering schools with the view to fitting the student for practical duties at the conclusion of his school course. The scope and facilities of this school were explained. He was followed by F. A. Vaughn, consulting engineer, and business manager of the school, who traced the school's growth, referred to its standing and showed what its facilities were by a large number of photo illustrations and motion pictures on a screen.

EDISON ILLUMINATING ASSOCIATION TO HOLD BUSINESS MEETING.

President Junkersfeld Resigns Because of Pressure of Military Duties.

On March 21, the Executive Committee of the Association of Edison Illuminating Companies held a brief meeting at Association headquarters, New York, the meeting being attended by J. W. Lieb, Charles L. Edgar, Walter F. Wells, L. L. Elden and Thomas E. Murray, representing W. W. Freeman.

Among other business transacted by the Committee, a communication from President Junkersfeld, under date of February 14, 1918, was read, in which he tendered his resignation as president of the Association, the reason given being that his increasing military duties prevented him from giving proper attention to the affairs of the Association. Mr. Junkersfeld has been serving at Washington as Major in the Quartermaster's Corps, N. A., for over a year and was recently promoted to the rank of Lieutenant Colonel. With the increased responsibilities of his new assignment, President Junkersfeld explained that he felt it

quite impossible for him to continue as president of the Association. The Committee was very loath to lose President Junkersfeld's leadership in Association affairs but realized that under the circumstances no other course was open but to accept his resignation with great regret.

As the general business conditions which made it desirable to dispense with the customary convention last year have not materially changed in the interim, it was decided by the Committee that the Association would hold a business meeting only this year. This will be held in New York on September 10 and will be similar to the brief meeting held in September of last year, unless the plan now contemplated is changed at a later date.

RELATION OF BUREAU OF STANDARDS TO ILLUMINATING ENGINEERING.

Most Important Illumination Researches of Bureau Described by Dr. M. G. Lloyd.

Many of the important contributions to illuminating engineering made by the United States Bureau of Standards were described in a paper presented by Dr. Morton G. Lloyd, electrical engineer of the Bureau, before the Chicago Section, Illuminating Engineering Society, on March 21. In the introduction, Dr. Lloyd showed the interrelation of illuminating engineering to physics, physiology, psychology, hygiene, architecture and decoration. For any dependable knowledge of light sources, their properties and equipment, quantitative measurements of these properties must be made. Since the eye is only a crude instrument for making most light measurements, it must be backed up by definite standards, by more refined methods of measurement, and by perfected measuring apparatus.

The development of such standards, measuring methods and apparatus constitute an important function of the Bureau, which is also concerned with scientific investigations bearing on still higher accuracy or permanence in any or all of them; it is also interested in optical researches, determination of physical constants of light, physiological properties of the eye, etc.; another line of activity is in drafting standard specifications and tests for lamps purchased by the Government, also standards for lighting service furnished by utility companies.

Dr. Lloyd then described in more detail the adoption of the international candle in 1910 by Great Britain, France and the United States, and how the standard lamps have been compared in the three countries since that time. These standards of light intensity are carefully seasoned carbon-filament lamps of 16 candlepower and operate at a specific consumption of four watts per candle; they are frequently compared among themselves and with similar standards in the British and French laboratories. They are quite permanent and in many ways superior to flame standards which are affected by many conditions. Methods of making photometric measurements where there are color differences in the sources being compared always employ the flicker photometer. Where one of the lamps used is of much higher intensity, a motor-driven sectored disk is used to cut off a definite part of its light. Rotating the lamp under test gives the mean horizontal candlepower with considerable accuracy, but where this disturbes the filament mirrors are rotated about the lamp. Gas-filled incandescent lamps cannot be rotated; they are usually photometered in an Albricht spherical photometer, which gives the mean spherical candlepower quickly and accurately. Testing of colored light sources has been studied at the Bureau for many years and the problem is being worked out of drawing up definite color specifications. Artificial daylight had been investigated about 10 years ago and several means for obtaining it pointed out.

In its work of establishing standards of quality for illuminating supplies purchased by the various government departments, the Bureau has recently revised the specifications for electric incandescent lamps, which constitute the principal item in this line. The method of testing lamps for watts per candle and for life was described. Life tests of vacuum tungsten lamps are accelerated by operating them at over voltage, the effect of this on life having been determined.

Investigations have also been carried out on the properties of gas mantle lamps, on automobile headlights, on the sensibility of the eye to light of different colors, on the protection of the eye from harmful radiations, etc. In the way of public utility lighting work, the Bureau has made investigations of the desirable specifications of electric and gas lighting service, and has drafted standards of service for each of these two classes of utilities. An extended investigation of street-lighting service is now under way, which aims to present the types of installations available, the results that should be secured, schedules suitable for street lighting and proper forms of lighting contracts.

The Bureau has also aided other Federal departments in helping to formulate safety standards in government industrial establishments.

WESTERN RED CEDAR ASSOCIATION ELECTS OFFICERS

Annual Meeting Held at Spokane, Wash., March 21.

The thirteenth annual meeting of the Western Red Cedar Association was held at the Davenport Hotel at Spokane, Wash., on March 21. The principal business was the presentation of the reports of the standing committees and the election of new officers for the ensuing year.

A general discussion took place relative to market conditions prevailing during the past year. It was the consensus of opinion that the demand for western red cedar poles during the year 1917 was about normal but that production was considerably below normal, due largely to shortage of labor. It was generally agreed that the actual cost of production has increased at least 50 per cent during the past year.

The election of officers resulted as follows:

President, O. S. Hanson, Spokane, Wash.

Vice-president, R. G. Jones, Ione, Wash.

Directors—E. T. Chapin, L. A. Page, Jr., and J. M. Montgomery.

Secretary, J. E. Seaman, Spokane, Wash.

The following committees were appointed by the board of directors for the ensuing year:

Advertising Committee: W. M. Leavitt, chairman; E. A. Lindsley, E. L. Clark.

Pole Committee: L. A. Page, Jr., chairman; W. M. Leavitt and M. P. Flannery.

Post Committee: F. C. Culver, chairman; H. E. Brown and J. M. Montgomery.

Piling Committee: E. T. Chapin, chairman; H. J. Searl and H. C. Culver.

Railroad Committee: C. P. Lindsley, chairman; T. J. Humbird and H. C. Culver

Official Inspection Committee: C. P. Lindsley, chairman; O. S. Hanson and R. G. Jones.

Commercial

Brooklyn Company Conducts War Stamp Sale—Wisconsin Rural Service Status—Compressed Air Aids War Work

BROOKLYN COMPANY CONDUCTS SALE ON WAR STAMPS.

Entire Sales Force Assigned to One Week's Campaign—Every Customer Solicited.

When the United States Treasury Department first issued War Savings and Thrift Stamps the lighting companies of New York City were organized into what was known as the Pioneer Division, for the distribution and sale of these stamps.

From the very beginning the Brooklyn Edison Company led the division and in fact has been among the leading 20 companies of the city who have been selling the stamps.

During the first part of March, T. I. Jones, general sales agent of the Brooklyn Edison Company, decided to make a special W. S. S. drive to take place the week of March 18 to 23, and accordingly, on March 17, an announcement was published in the Brooklyn newspapers, regarding the sale. This announcement is reproduced herewith. As will be noted in the announcement, the salesmen of the company discontinued their regular work for four hours each day during which period they canvassed Brooklyn Edison customers in an effort to sell War Saving and Thrift Stamps. Keen rivalry existed not only between the different offices of the company but between the men themselves.

One district manager had remarkable success by securing permission from the proprietors of factories to give a short talk to their employes. At the conclusion of the talk, the boss usually started the ball a rolling, and in almost every case at least one stamp was sold to each employe.

To Brooklyn Edison Customers

In order to popularize electricity and demonstrate its value in the home this Company for the past four years has been conducting monthly special sales on selected electric appliances. Concentration on one appliance for a specified period seems to produce satisfactory results.

In order to accelerate the disposition of War Savings Stamps which for some time have been, and now are, on sale at each of our Company offices, we have decided to have our entire force concentrate on their sale for one week.

Beginning, therefore, Monday, March 18, salesmen of the Edison Company will call on Brooklyn Edison customers in an endeavor to sell War Savings Stamps. No compensation of any kind is obtained by the Company from this sale and the work of these salesmen is merely an individual effort in connection with the Company's policy of endeavoring to do its bit.

May we bespeak a courteous reception for the Edison salesmen from each Edison customer. If War Savings Stamps have been purchased kindly advise him. If they are not desired, so state—but in any event accept his call in the spirit in which it is made.

EDISON ELECTRIC ILLUMINATING CO.
OF BROOKLYN

Announcement of Sale by Brooklyn Edison Company.

On March 20 a second announcement was inserted in the Brooklyn papers, entitled, "Have You Done Your Bit." This is reproduced herewith.

All branch office windows of the company were dressed with W. S. S. material which added greatly to the success of the drive. The company's billboard at

Have You Done Your Bit?

This week salesmen of this Company are calling on Edison customers with War Savings Stamps for sale.

Thus far our men have been most courteously received and many stamps sold.

No compensation of any kind is obtained by the Company from this sale and the work of these salesmen is merely an individual effort in connection with the Company's policy of endeavoring to do its bit.

All customers will be visited before the week ends and their co-operation in this government work is earnestly solicited.

Edison Electric Illuminating Co. of Brooklyn

Second Advertisement of Campaign to Sell Stamps.

Atlantic avenue, opposite the Long Island Railroad and subway stations was painted with the words, "Have You Done Your Bit? Buy War Saving Stamps Today."

The daily record of the sales department individual results were as follows:

	March 18th.	19th.	20th.	21st.	22nd.	23rd.
Thrift stamps.	1,118	817	1,082	1,705	1,411	1,761
War stamps .	85	75	120	171	164	294
Daily total.	$631.40	$ 514.75	$ 767.30	$1,134.19	51,029.71	$1,857.11
Accumulative total	631.40	1,146.15	1,913.45	3,047.64	4,077.35	5,734.76

In addition to the above, stamps were sold over the counters of all offices of the company at the time of signing contracts, selling appliances or paying bills. Department heads throughout the company also organized local W. S. S. drives for their own employes and for the public with whom they came in contact.

The total of the week's work and also the grand total of the Brooklyn Edison Company activities up to and including March 23 are as follows:

	Thrift.	War.	Amount.
Sales department	7,886	908	$ 5,734.76
Other departments	3,185	157	1,446.23
Branch offices	3,319	259	1,819.21
	14,390	1,304	$ 9,000.20
Company total to date (3-23-18)..	29,211	2,635	$18,196.34

Memphis Company Distributes Rebates on 1917 Bills.

Distribution of slightly over $16,000 in rebates for the reduction of the light rates in 1917 is being made by the Memphis Gas & Electric Company, Memphis, Tenn. The rebates are distributed under the terms of an agreement with the city whereby customers will receive the advantage of the lower rate which is fixed for electric lights. The rebates range from two cents to $3.00 and average $1.23.

STATUS OF RURAL SERVICE IN WISCONSIN.

Compilation of Data by Committee on Rural Service, Wisconsin Electrical Association.

At the annual convention of the Wisconsin Electrical Association, held in Milwaukee on March 27-28, the committee on rural service submitted its annual report. This report includes a large amount of interesting information apropos rural distribution, loads and load densities. In the report the committee has followed the form and scope of the Rural Service Reports of the two previous years, in order to make comparisons covering this branch of the utility business more readily intelligible. Investigations along lines similar to those pursued in previous years have been carried on and they cover the following points:

(1) How many utilities in the state of Wisconsin serve rural customers and what are the standard methods of making extensions to serve them. What are the connected loads and the transformer capacities to serve these customers and what are the annual revenues secured from them.

(2) To what extent has the rural business increased or decreased during the year 1917.

(3) What is the evidence indicating that this class of business is or is not desirable and profitable.

Blanks similar to those sent out in previous years were forwarded to all electric utilities in the state and some correspondence carried on with a few out of state companies.

Requests were made for a separation of data pertaining to light and power, but in a majority of cases reported it seemed to have been impractical for the companies to make such a separation, hence in this report combined results only are considered.

Tabulated data taken from replies of the companies are found in Tables I and II and the analysis of growth, etc., in Table III.

The total number of companies reporting rural customers this year was twenty-six, against twenty for last year. Four companies who reported thirty-two customers in 1916 did not report in 1917, but six companies who did not report rural customers last year, reported 288 rural customers this year. Assuming that companies who had these customers in 1916 still have at least approximately the same number, the increase in the number of companies reporting rural customers is 8 and the increase in the number of rural customers, under the same assumption, is 287 or 63 per cent. This is quite likely not a true indication of the growth in the number of rural service customers but may be taken as a substantial indication that the number of rural customers is increasing.

An analysis of Table I, which covers reports from twenty-six companies (a large majority of the electric utilities in Wisconsin supplying rural electric service), brings to light the following facts:

(1) In a moderate majority of cases the farmer pays for the extension of primary lines.

(2) The cost of transformer installations is carried by the farmer in less than one-half the cases reported and by the company in the remaining cases.

(3) In about one-half the cases the farmer pays for the extension of the secondary lines.

(4) In a majority of cases no refund on the cost of the extensions is made to the farmer where he has contributed to the expenses of such extension.

(5) In about one-half the cases single phase motors only are provided for on rural extensions and provisions for motors over 5 h. p. capacity single phase are exceptional. Polyphase motors are provided for in about one-half the cases reported.

(6) In a majority of cases lines have not been constructed exclusively for rural service customers, but have been extended from city lines into well settled suburban or rural districts. A considerable portion of the rural customers obtain service from low voltage transmission lines, where the transmission voltage (up to and including 6600 volts) is stepped down direct to 110 or 220 volts.

(7) Reports as to whether this class of business is considered profitable or not are divided about equally in the affirmative and negative.

Table II is self explanatory, but a few supplementary remarks may make it more readily understood.

TABLE I—COMPANIES REPORTING RURAL SERVICE (WISCONSIN)—1917.

Location of company.	No. cust.	Max. dist. from sta.	Farmer pays for Prim.	Trans.	Sec.	Meter.	Refund.	Current 10.	30.	phase Dir.	Max. size motor.	Lines for rural service only.	Profitable.	Trans. volt.	Lines step down direct.	Invest. per Kw. conn. load.
Appleton	35	4	N	N	N	N	..	Y	..	..	5	Y	Y	2200	Y	..
Baraboo	52	..	Y	N	Y	N	Y	either		..	5	N	?	6600	Y	..
Beloit	33	3½	Y*	N	Y	N	N	either		..	20	N	Y	2300	Y	..
Burlington	2	1	Y	N	Y	N	Y	Y	..	..	7½	N	N	26400	N	..
De Pere	6	1½	Y*	N	N	N	..	..	Y	..	1	Y	N	2200	Y	..
Durand	6	5	N	N	N	N	..	Y	..	..	5	Y	N	6600	Y	..
Edgerton	52	5	Y*	N	N	N	..	Y	..	..	..	Y	Y	2300	Y	..
Ft. Atkinson	17	1½	Y	Y	Y	N	N	either		..	5	N	Y	2300	Y	..
Glenwood	7	3½	Y	Y	Y	N	N	Y	..	..	15	N	Y*	2300	Y	..
Grafton	14	3	N	N	Y	N	N	Y	..	..	..	N	Y	2200	Y	..
Green Lake	3	2	N	N	N	N	Y	either		..	2	N	Y	.....	..	..
Hudson	4	7	Y	Y	Y	N	N	..	Y	..	10	N	N	13200	Y	..
Janesville	29	5	Y*	N	N	N	N	either		..	..	Y	Y	6600	Y	..
Lake Geneva	8	10	..	..	..	..	..	Y	..	..	5	Y	Y	26200	N	..
Lake Mills	12	5	Y	Y	Y	Y	..	..	Y	..	2	Y	..	6600	N	..
†Mineral Point	10	1	Y	Y	Y	N	Y	Y	..	..	..	N	..	13200	N	..
Oakfield	4	5	Y	Y	Y	N	N	..	Y	..	15	Y	N	6600	Y	..
Oshkosh	33	..	..	..	..	..	..	..	..	..	..	N	..	.....	..	..
Rhinelander	4	2	Y	N	N	N	N	Y	..	..	10	N	N	12000	N	..
Rice Lake	..	..	N	N	N	N	N	Y	..	..	15	N	N	6600	Y	..
Sheboygan	120	9	Y*	N	N	N	Y	either		..	..	Y	N	13200	Y	..
†Sturgeon Bay	21	2½	Y	Y	Y	Y	N	Y	..	..	3	N	Y	2300	Y	..
Washburn	10	3	N	N	N	N	..	Y	..	..	..	Y	N	2300	Y	..
Watertown	11	10	Y	N	Y	N	N	Y	..	..	10	N	?	{ 4800 } { 13200 }	Y N	.. ..
Wausau	8	3	N	N	N	N	N	either		..	..	Y	N	22000	N	..
‡Winona office reporting	255	12	..	..	..	N	N	either		..	3	N	Y	6600	Y	178
Wittenberg	5	9	Y	Y	Y	N	N	Y	..	..	10	N	N	6600	Y	..

*Partly paid by customer. †1916 report. ‡Partly Minnesota.

The first column gives the location of the utility.

The second column gives the kilowatt connected load of rural customers for each utility.

The third column gives the kilowatt-hours consumed by all rural customers of each utility.

The fourth column gives the total kilowatt capacity of transformers installed by each utility for this class of service.

The fifth column gives the total operating revenue per year per utility.

The sixth, seventh, eighth and ninth columns give statistics per consumers.

The tenth, eleventh and twelfth columns give statistics per kilowatt transformer capacity.

The last column gives the average operating revenue per kilowatt-hour for each utility, the average for all utilities being 6.9 cents per kilowatt-hour.

It is interesting to note that this selling price per kilowatt-hour average is obtained with an average transformer capacity per consumer of 1.6 kilowatt and an average connected load per consumer of 1.4 kilowatt.

Table III recapitulates the findings of the committee in condensed form and compares the findings of 1917 with those of 1916. The following inferences may be reasonably deduced from the data shown.

(1) There is an apparent increase in the number of companies furnishing rural service and in the number of rural consumers being served.

(2) The reported maximum distance of distribution has decreased, indicating an increase in saturation of service.

(3) A decrease in total kilowatt-hours consumption but an increase in total operating revenue. The decrease in total kilowatt-hours consumption is due to one of the largest companies reporting 217,000 kilowatt-hours' less consumption in 1917 than in 1916. In general, the kilowatt-hour consumption shows an increase.

(4) A slight decrease in connected load and the same step down transformer capacity per consumer, but a noticeable decrease in the average revenue per consumer, which, on account of the greater kilowatt-hour consumption per customer, would indicate a greater use of the connected load, but a lower average rate per kilowatt-hour sold.

(5) There is an apparent increase in the kilowatt-hours sold per kilowatt of transformer capacity, which would indicate also a tendency toward greater use of the connected load.

(6) An apparent increase in revenue per kilowatt of transformer capacity, although at a lower rate per kilowatt hour, would also indicate a greater use of the connected load than in 1916.

It should be noted that in computing the units under the last three headings of Table III figures only were used where both component parts of the desired unit were reported. This method gives a reliable unit for all companies reporting the necessary information to compute a given average unit.

Passing from the consideration of the foregoing statistical data to a more general discussion brings out the fact that several of the largest electrical utilities of the state, including such as the Milwaukee, Madison, Racine, Kenosha and Waukesha companies, have not as yet indulged extensively in the rural service experiment. The new schedule adopted by the Wisconsin Gas & Electric Company referred to in last year's report and first applied in the Watertown division during 1917, promises to give fair results, due to the reasonably high minimum monthly charge. Eleven farms were connected up during the year and more are preparing for connections.

Due to a general retrenchment of all companies in the programs of capital expenditures during the last half of 1917, very little was done along the line of extensions, especially rural extensions. However, even with the present prospect of a shortage of capital for extensions of all kinds, the development of rural service near existing lines may proceed, due to the shortage and demands of farm labor.

No canvass of the rural service situation in neighboring states was made, but a quotation from a letter received from Mr. C. C. Miller, Vice President of the Northeastern Iowa Power Company, main office at Clermont, Iowa, is of interest in this connection:

"We have followed the rural service in our territory for a number of years and find that if the mini-

TABLE II.—RURAL STATISTICS—WISCONSIN. LIGHT AND POWER COMBINED—1917.

Location of company.	Total: No. cust.	Total: Kw. conn. load.	Total: Kw.-h. per yr.	Total: Trans. cap., Kw.	Total: Op. rev. per year.	Per customer: Conn. load, Kw.	Per customer: Kw.-h. per year.	Per customer: Trans cap., Kw.	Per customer: Op. rev. per year.	Per Kw. trans. cap.: Kw.-h. per year.	Per Kw. trans. cap.: Conn. load, Kw.	Per Kw. trans. cap.: Op. rev. per year.	Rev. per Kw.-h. cents.
Appleton	35	27	10,000	35.0	$ 967.00	.8	286	1.0	$27.63	286	.8	$27.63	10
Baraboo	52	..	.....	....	.....	...	...	...	.....	...	...	.....	..
Beloit	53	73	17,745	99.0	1,405.50	2.2	538	3.0	42.59	179	.7	14.19	8
Burlington	2	2	440	1.0	42.76	1.0	220	.5	21.38	440	2.0	42.76	10
De Pere	6	48	.....	60.0	.....	8.0	...	10.0	.....	...	.8	.....	..
Durand	6	8	.....	12.0	180.00	1.3	....	2.0	30.00	....	.7	15.00	..
Edgerton	53	43	12,928	60.5	913.06	.8	244	1.1	17.23	214	.7	15.10	7
Ft. Atkinson	17	25	8,648	23.5	670.71	1.5	509	1.4	39.45	368	1.1	28.54	8
Glenwood	7	8	1,986	12.0	238.00	1.1	284	1.7	34.00	166	.7	19.83	12
*Grafton	14	15	3,500	40.0	375.00	1.1	250	2.9	26.79	88	.4	9.38	11
Green Lake	3	4	1,143	33.0	124.05	1.3	381	11.0	41.01	26	.1	3.76	11
Hudson	4	35	.....	40.0	455.00	8.8	....	10.0	113.75	....	.8	11.38	..
Janesville	29	55	20,187	53.5	1,095.38	1.9	696	1.8	37.77	377	1.3	20.47	5
Lake Geneva	8	7	5,771	19.0	338.54	.9	721	2.4	42.32	304	.4	17.82	6
Lake Mills	12	25	7,800	20.0	624.00	2.1	650	1.7	52.00	390	1.3	31.20	8
†Mineral Point	10	3	2,066	4.0	229.72	.3	207	.4	22.97	517	.8	57.43	11
Oakfield	4	..	3,538	....	227.39	...	885	...	56.85	...	...	.....	7
‡Oshkosh	37	..	7,293	....	756.00	...	197	...	20.43	...	...	.....	10
Rhinelander	4	3	1,709	....	117.43	.8	427	...	29.36	...	...	.....	7
Rice Lake	..	..	.....	....	.....	...	...	...	.....	...	...	.....	..
Sheboygan	120	197	109,949	....	4,878.64	1.6	916	...	40.65	...	...	.....	4
‖Washburn	10	..	.....	....	.....	...	...	...	.....	...	...	.....	..
*Watertown	11	15	6,600	20.0	400.00	1.4	545	1.8	36.36	300	.8	20.00	7
Wausau	8	12	5,478	...	514.96	1.5	685	...	64.37	...	...	.....	11
Winona	248	256	85,279	158.5	7,634.88	1.0	344	.6	20.79	538	1.6	48.17	9
Wittenberg	5	9	.....	9.5	103.00	1.8	...	1.9	20.60	...	.9	10.84	..
	739	871	311,460	786.0	$22,271.02								

*Estimated. †1916 report. ‡Reports rural service but gives no details. ‖No detail reported.

mum bill is maintained high enough this farm service would be very desirable from the electric company's standpoint in the future. The trouble that we have found with many of the companies, and in fact we have experienced this ourselves in the start, is that they charge too small a minimum bill which works a hardship on the power company, owing to the fact of the existing transformer losses, etc.

From my knowledge of the situation there has not been an extensive development of farm service in the state of Iowa. I think that perhaps 50 per cent. of the companies have followed it and practically all the business has been offered them, as there has been but very little solicited.

TABLE III (RECAPITUATION)—COMPARATIVE STATISTICS OF 1916 AND 1917 (RURAL SERVICE), WISCONSIN, LIGHT AND POWER SERVICES COMBINED.

	1916.	1917.	Increase.
Total companies reporting	40	37	—7%
Companies reporting customers	20	24	20%
Number of customers	419	738	76%
Average number of customers per company reporting rural customers	21	30	42%
Maximum distance from station	18	10	....
Total connected load, Kw.	331	871	163%
Kw.-h. sold per year	446,493	311,460	—32%
Total transformer capacity, Kw.	364	786	116%
Total operating revenue	$18,609.00	$22,271.02	19%
Data per customer (arithmetical average)—			
Kw. connected load	2.0	1.4	—30%
Kw.-h. sold per year	367	475	29%
Transformer capacity	1.6	1.6	same
Operating revenue per year	$39.00	$33.00	—15%
Data per Kw. of transformer capacity (arithmetical average)—			
Kw.-h. sold per year	233	255	9%
Kw. connected load	.8	.8	same
Operating revenue per year	$20.00	$22.00	10%
Operating revenue per Kw.-h. (arithmetical average)—	9c	6.9c	—23%

Remarks—One company reporting 248 customers in 1917, did not report in 1916.

We have about 200 miles of transmission line and on these 200 miles we have 125 customers which are being served under a contract which works out very satisfactorily from both the company's and consumer's standpoint.

Practically all of the rural business must be put on single phase owing to the fact that the cost of transformer and service on a three-phase line would be too great, also that farmers as a rule are small consumers and install nothing larger than 3 or 5 h. p. motors. A single-phase equipment is just as satisfactory as a polyphase.

We have many communities along our transmission line where we get 20 farmers on a 5-mile line and expect to put on a lot more on our territory during the season of 1918."

Finally, the committee considers that there is no reason for changing the 1916 summary of the Rural Service conditions for Wisconsin, when considering the 1917 conditions, viz.:

(1) The construction of purely rural service lines is not ordinarily warranted unless the saturation of service is such that a reasonable return on the added investment and sale of energy may be shown.

(2) Rural service consumers on transmission lines of not over 6600 volts connecting towns or villages are ordinarily profitable if a suitable minimum charge is made.

(3) A suitable minimum charge to cover the higher cost of service for rural consumers should be made, variously estimated at from $2.00 to $3.00 or over per month.

(4) A low second step in the energy rate should be provided so as to encourage a sufficient use of the service by the farmer to make it practical and attractive to him.

DEVELOPING SALESMANSHIP AMONG EMPLOYES OF PUBLIC SERVICE COMPANY.

Streator, Ill., is headquarters of Division S of Public Service Company of Northern Illinois. This division embraces the 12 towns of Streator, Toluca, Minonk, Benson, Rutland, Tolica, Lostant, Grand Ridge, Ransom, Kinsman, Verona and Mazon, having a combined population of about 30,000. The territory has about 75 employees, variously engaged, who are taking up as a side issue the matter of securing orders for electrical appliances and service, for which the company pays 5 per cent commission. They do this work in a manner and at such times as will not interfere with their regular work. Under the leadership of J. M. Willard, division superintendent, meetings of employees are held for dissemination of selling ideas and to become informed on the uses and merits of appliances offered for sale. The plan likewise contemplates having addresses or selling talks at those meetings by salesmen of experience. This sales work is so laid out as to create some rivalry among the men of the several towns in the division. The work outlined will be well under way with the opening of spring, and it is believed will result in developing the salesmanship gift and in educating the employees in the proper use of the things they seek to sell. It will bring out a certain amount of adaptability upon which depends the success of those who try. It is figured that every employee, who takes advantage of the company's offer, has certain friends to whom he can make sales; and that a new customer has friends susceptible of being interested in like manner. The plan is to follow a schedule, developed at the company's general offices, under which efforts will be centered on a line of appliances at the same time.

A number of electric ranges have been sold at Grand Ridge, Rutland and Minonk. Window displays of electrical appliances at the various division stores will receive renewed interest with the opening of spring, and the plan is to give the display a new make-up every month.

COMPRESSED AIR AIDS WOMEN IN WAR WORK.

In England for the heavy chucks used with large power-operated lathes instead of relying upon manual power to close and open the chuck compressed air is largely used. This saves the womens' energy, in fact, making possible work that probably could not otherwise be done by them, reduces time of setting up and taking down the job, and thus speeds up production. It is claimed that the use of compressed air in this way increases production from 20 to 100 per cent while the effect is, of course, toward better work since the worker is less fatigued and is better able therefore to concentrate her mind on the actual work on hand.

Electricity has not only found its way to individual drive of the lathe and other machines, but the use of compressed air for above purpose requires a motor-driven compressor, from which the air is piped to the various machines. Duplicate units are advisable so that failure of one unit may not affect the machine shop as a whole. The load-factor of these units is high and the load practically a constant one during the working day because of the diversity of the individual workers.

Operating

Transmission Line Nomenclature—Transformer Vaults—Banking Transformers—Finding Opens in Series Circuits

IDENTIFICATION NOMENCLATURE OF TRANSMISSION LINES.

Interesting Method Employed by Portland Railway, Light & Power Company for Specifying Transmission Lines.

The ways of identifying transmission lines, whether overhead or underground, are many. And the reasons advanced for employing them are as numerous. Sometimes the direction of normal current flow, sometimes the station number from which the lines emerge, voltage and location are chosen as the factor upon which identification is based.

The method employed by the Portland Railway, Light & Power Company is an interesting example of identifying a network of transmission lines. The method will be of special interest at this time with the movement toward interconnected systems, since the system is interconnected with several other systems and more than a half dozen power plants of their own ranging from 250 to 14,250 kilowatts. With many power houses and points of interconnection with other companies the method of identifying or specifying lines is usually more complicated than when only one company or one or two power houses are involved, because of the different voltages, frequences, forms of energy, and so forth. In such cases it is obviously advantageous to be able to accurately imply all factors involved in the form of identification employed.

The transmission system of the Portland Railway, Light & Power Company has connected to it some 65,280 kilowatts in generating capacity, 22,400 generated by steam and 42,880 by water. It employes transmission voltages of 11,000, 18,000, 33,000 and 57,000, and two different frequencies, namely, 33 and 60 cycles, the systems of which may be tied in together by means of frequency-changers. Moreover, many of the lines are what may be called convertible lines, that is, may be used for either 33 or 60 cycles, according to operating convenience.

With the method of identification in vogue, both voltage and frequency are given in the line identifying number, in addition to the actual number of the line. Where a line is convertible—that is, may be used for 33 or 60-cycle current—this also is included in the line number. In this way load despatching is simplified, mistakes are reduced, and mention of a line number implies a number of details that otherwise might mave to be explained. This is an important feature where telephone conversations have to be carried on over noisy lines. An example may make the method employed clearer. Suppose a line is given the number 11612. This implies, firstly, that the line operating voltage is 11,000 volts (left hand digits). Secondly, that it is a 60-cycle circuit, as 6 is the middle digit. Thirdly, that the actual indicating number of the line is 12, since the right-hand integers are 1 and 2, respectively. In other words, reading from left to right, first the voltage is specified, next the frequency, and, thirdly, the identifying line number. A line numbered 33305 means that line number 5 is for 33,000-volt service and 33 cycles.

Convertible lines employ 4 as the middle digit to indicate either 33 or 60 cycles. Thus a line numbered 11445 menas that line 45 may be operated at 11,000 volts on 33 or 60 cycles.

PROPORTIONING VOLUME OF TRANSFORMER VAULTS ACCORDING TO TRANSFORMER CAPACITY.

Each year sees more overhead conductors placed underground. Every year sees more large energy consumers going over to central-station service. Both of these occurrences result in more and more transformers being installed underground in manholes, transformer vaults or in closed-in-rooms or houses upon the customer's premises.

The ventilation of these inclosed transformer housings is an important one, because it affects the life of apparatus and quality of service, thus the amount of space per unit of transformer capacity that should be allowed is a matter of interest. At the 338th meeting of the A. I. E. E. held in Cleveland recently, in a paper entitled "Design of Underground Distribution for Electric Light and Power Systems," G. J. Newton pointed out that the amount of transformer capacity which can be installed in a vault depends upon operating conditions. For capacities up to 200 kilowatts, and under favorable conditions, 3.5 to 4.0 cubic feet of vault space per kilowatt is a safe figure, which corresponds fairly closely with the rule of allowing 8 watts transformer loss per square foot of radiating surface in the vault.

To make the matter clearer, assume four 50-kilowatt transformers are installed in a vault measuring 10 by 10 by 7 feet in height. A transformer of this size has 240 watts core loss and 550 watts copper loss, or a total per transformer of 790 and 3160 watts for all four transformers. A vault of the dimensions given above has a volume of 700 cubic feet and 380 square feet of radiating surface, including walls and ceiling. If 3.5 cubic feet per kilowatt are allowed, 700 cubic feet is exactly the space required. Applying the rule of 8 watts loss per foot of radiating surface gives 3040 watts, which is sufficiently close to the actual for practical purposes.

The above proportioning of vault volume and radiation surface to transformer capacity is based upon the assumption of full load continuously. In normal distributing systems, however, this rarely is the condition, and when full load occurs it is only for short periods. The temperature rise to be expected with the above proportioning of transformer vault may therefore be expected to be on the safe side, for capacities up to 200 kilowatts. Nevertheless, ventilation and ample space in a vault are always desirable.

OPERATING DETAILS OF BANKING TRANSFORMERS.

Features of Circuit Layout for Preventing Service and Transformer Failures.

In a paper entitled "Grouping of Transformers" read before the Minnesota Electrical Association recently, S. B. Hood, electrical engineer, Northern States Power Company, Minneapolis, described a number of interesting experiences in connection with the banking of distributing transformers for city distribution. After reviewing the growth of alternating current distribution, and the adoption of practices used for direct current three-wire work, various precautions to be guarded against when banking transformers were discussed. After covering the differentiation between an earth and water-pipe ground, the choice of transformer size, the necessity of earthing secondaries and the fusing of primary and secondary, many details connected with preventing cessation of service due to interconnection were taken up.

Fig. 1.—Diagram Showing Congested Load Carried By Circuit Strung Along Single Street.

One of the conditions that may cause trouble unless guarded against is shown in Fig. 1. This is typical of many districts where the congested load is strung out along a single street. Assuming that the transformer units have been properly standardized and their sections properly proportioned, all may appear well. However, suppose that unit A fails. Transformer B then takes practically all its load or about 100 per cent overload. This unit also soon fails, followed by units C and D, causing a serious and quite extensive shut down.

The solution of the difficulty is quite easy and consists of only loading the transformers feeding these end sections to 50 per cent of their capacity. This method is not very economical of transformer capacity, however, hence end sections should be eliminated wherever possible. Where such an end section is an extension from the main ringed network the best way to accomplish this is to run heavier secondary copper from the nearest ring, as illustrated in Fig. 2.

As to primary distribution. With distributed loads any ordinary primary layout works fairly well under normal load conditions. If a broken primary wire occurs, however, trouble surely follows. Consider the

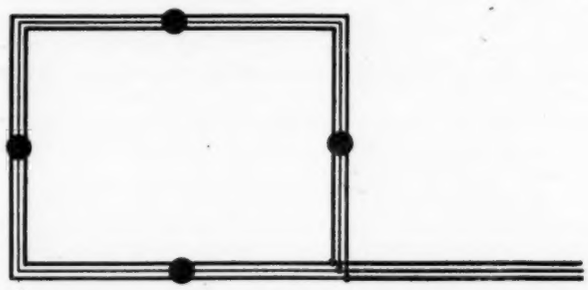


Fig. 2.—Diagram Showing Method of Connecting Straight Runs of Line With Adjacent Rings by Reinforcing Secondary Copper.

case illustrated in Fig. 3. Suppose that a break occurs in the primary between transformers B and C.

The primary current flows as far as transformer C, steps down to secondary voltage, flows through sec-

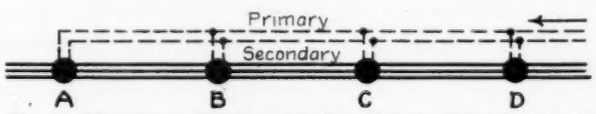


Fig. 3.—Diagram Indicating Straight Section With Circuit in Primary.

ondary main between B and C and up again through B. Now, the network is not designed as a transmission system and B and C fail, followed by A and D, and so on, until every transformer on the network is cleaned out, and considerable service interruption fol-

Fig. 4.—Diagram Showing Reinforced Primary to Prevent Troubles Due to Open Primary.

lows. This may appear to be an unusual condition, but it happens oftener than is supposed. The cure is simple, and in a properly designed ring or gridiron network works out also as an economy as well as to more evenly distribute the primary voltage. Always connect the primary in rings where possible and never put automatic cutouts in these rings. Where this is

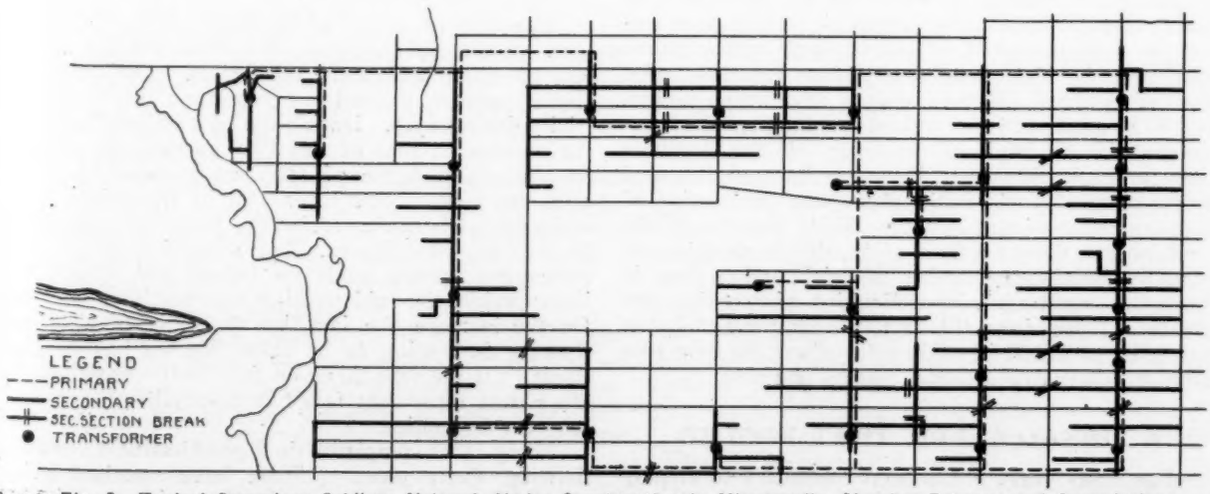


Fig. 5.—Typical Secondary Gridiron Network Under Construction in Minneapolis, Showing Primary and Secondaries Made Up of Series of Interconnected Rings.

not possible, as in Fig. 4, double up or loop the primary until after the second transformer from the end of the dead end spur has been passed.

Fig. 5 illustrates a typical secondary gridiron network such as is now in progress of construction in Minneapolis. It will be noticed that the entire network, both primary and secondary, consists of a series of interconnected rings, and that a broken wire at any point will not cause interruption of continuity of service, provided, of course, that a short circuit is not caused by the break.

In conclusion it was pointed out that before attempting to lay out an interconnected system, accurate single line diagrams of all circuits should be drawn out, so as to give a comprehensive insight into the system from which a permanent scheme may be based.

SIMPLE METHOD OF FINDING OPEN CIRCUITS IN SERIES LIGHTING CIRCUITS.

E. N. VICKERY,

Superintendent, Central Maine Power Company.

Open circuits due to either troubles in the lamps or actual breaks in the conductors insist on occurring occasionally in street-lighting circuits, whether employing arcs or tungstens. Often these opens occur for no apparent reason and at any time, hence series circuits have to be watched even when not in service lest the circuit become open between the time it is opened in the early morning and the night when lights are needed again. One way to make sure a circuit is closed while not in service is to ring it out every hour with a magneto or in some other way determine its continuity. This precaution prevents a circuit remaining open-circuited all day and not being discovered till the last moment when the lights are needed.

When a circuit is found to be open-circuited it then remains to locate the break as quickly as possible, especially if this occurs during the time that lights are needed. One way of locating the position of the break employed by this company to good advantage, which means, of course, rapidity of locating the trouble, is as follows: One side of the circuit is opened close to the source of supply. This may be at the tub regulator in the station, immediately outside or other convenient place. A lineman then goes to about the center of the circuit in trouble and scrapes a piece of insulation off the conductor so as to bare the conductor about ½ inch. As this circuit is alive from one end the lineman should, of course, wear rubber gloves and treat the circuit and everything connected with it as being "hot." If the circuit is alive at the section bared a spark will be noticed on tapping the conductor with the blade of the knife. If the circuit is dead no spark will occur. Knowing the route followed by the circuit, by trial in the above way the location of break or open circuit can be quickly found. While applicable to day as well as night, this method is particularly satisfactory during the night, when time is more important and the difficulties of working are greater. Apart from this test this company makes it a practice to test at junction poles where the loop arcs back, thus allowing a double test on one pole.

A SIGNAL ALARM THAT FOOLED.

For many years it has been customary to employ some form of signal to indicate the condition of electrical apparatus. For example, it is often the practice to install lights on generator panels to show by the color of the light whether the machine is running or not. Sometimes audible instead of visible signals are used; for example, a bell instead of a light. Often it is advantageous to employ both visible and audible signals.

One of the most common places at which to install some form of alarm or signal is on circuits, so that should they open, a bell rings or a light lights, or both. These alarms improve the quality of service since they enable abnormalities to be brought to light more quickly than otherwise would be the case. On the other hand, they tend to reduce the vigilance of the operating personnel, which is not desirable, although it is well to save them as much needless work as possible. With automatic equipment it is generally recognized, however, that some form of signal is advantageous to indicate the interruption of load or change in condition of apparatus.

That these alarms may actually serve good purpose and not give a feeling of false security, nor fool the operator, it is important that they be installed in the circuit in such fashion that they cannot fail to operate when occurs what they are intended to indicate. In other words, an alarm installed to indicate when current ceases on a line by opening of the circuit breaker should operate whenever the circuit breaker operates. A circuit that depends upon current flow should operate if current flow ceases.

In one recent case in a large operating company it had been the practice to install contacts upon the overload current tripping relays, operated from the secondary of the current transformers. When the current attained a certain value, the relays operated and opened the circuit breakers. These relays were tested every week and the bell-ringing element every day. However, one day it was found that current had been off one line some 10 minutes during the heavy lighting peak, but the operator failed to notice it because the bell did not ring. The circuit breaker had fallen out from vibration or similar cause, and as the overload relay had not been called into action, the alarm had failed to notify the operator of the condition. The remedy was, of course, to install the alarm contacts on the oil circuit breakers instead of upon the overload relays.

ELECTRIC THAWING FINDS INCREASING FAVOR.

Thawing of water pipes electrically, while long since advocated, is beginning to become a really important operation with some companies. The Duquesne Light Company thawed out 70 water pipes with electricity during 1917. During the past winter, however, the number of jobs of this kind carried out reached the surprising figure of 1069, an increase of about 1600 per cent. Ninety per cent of these jobs were residential, where the service line from the main street to the house was frozen. The remaining 10 per cent were pipes frozen inside the houses and commercial jobs. While the cold weather was partly responsible for the increase, the fact that the value of electrical thawing is coming to be better known has had its effect. Of the jobs taken on for electric thawing not more than 1 per cent failed to materialize because of inherent difficulties.

Many other companies do a good business annually thawing water pipes. Some have standard price schedules; others have agreements with the city at definite price based upon pipe sizes. It's good business.

Contracting-Construction

Sections 34 and 35 of Part III, National Electrical Safety Code—Estimating Contracting Costs—Motor Installations

PART III OF THE NATIONAL ELECTRICAL SAFETY CODE.

Rules for the Installation and Maintenance of Electrical Utilization Equipment—Sections 34 and 35.

[*The* ELECTRICAL REVIEW *has found that electrical contractors are quite unfamiliar with the National Electrical Safety Code, drafted by the Bureau of Standards, Washington, D. C. This new Code aims to minimize the life hazards connected with the use of electricity. Part III of the Code is of special importance to contractors, who will be called on more and more to make their installation work conform to its requirements. To acquaint them with this portion of the Code, Part III is being reproduced in these columns, Sections 30 to 33 having appeared in the issues of March 16, 23 and 30, Sections 34 and 35 with discussion appear below. The remaining sections of Part III will appear in the following issues.*]

SECTION 34.—MOTORS AND MOTOR-DRIVEN MACHINERY.

340. Control Devices.

(*a*) Separately excited direct-current motors, also series motors, and motor-generators and converters larger than 10 kilowatts where it is possible for them to be driven at excessive speed from the direct-current end, as by a reversal of current or decrease in load, shall be provided with speed-limiting devices, unless the load and the mechanical connection thereto are of such a character as to safely limit the speed.

(*b*) Where the speed control of direct-current motors is accomplished by varying the field resistance, and the nature of the load and the range of the field rheostat are such as to make a dangerous speed attainable, and no speed-limit devices are used, the field rheostats shall be arranged with no-voltage releases or other devices so that the motor can not be started or continued in operation under dangerously weakened field, except where the operation of such a no-voltage release might result in serious injury to service or apparatus.

Motors which are designed to permit starting safely under weakened field are not included in the above.

(*c*) Manually controlled starters for motors shall be so designed and circuits so arranged that they return automatically to the "off" or starting position upon failure of the energy supply, except where the motors and their starting devices are, during operation, under supervision of qualified persons and equivalent protection is otherwise provided.

(*d*) Where speed-limiting devices or remote-control switches are electrically operated, the control circuits by which such devices are actuated shall be adequately guarded, by conduit or otherwise, against mechanical injury.

341. Hazardous Locations.

Motors in which sparking or arcing can occur during operation shall where practicable be kept out of locations where explosives or inflammable gas or inflammable flyings exist. Where necessarily in such locations they shall be suitably protected. (See Rule 307.)

342. Deteriorating Agencies.

(*a*) Suitable guards or inclosures shall be provided to protect exposed current-carrying parts of motors and the insulation of motor leads where installed directly under equipment or in other locations where dripping oil, excessive moisture, steam, vapors, chemicals or similar injurious agents exist.

(*b*) The metal frames and other exposed non-current-carrying metal parts of equipment in these locations shall be permanently grounded. (See Rule 304 *c*.)

343. Guards for Live Parts.

(*a*) Motors operating at over 150 volts to ground, unless isolated by elevation at least 8 feet above the floor line, should, if practicable, be provided with permanent inclosures or other suitable guards so arranged as to prevent persons or conducting objects from inadvertently coming or being brought into contact with live parts or interfering with the operation of the motors.

(*b*) Suitable insulating mats or platforms of substantial construction and providing good footing shall be so placed on floors and, if necessary, on frames of machines having exposed live parts above 150 volts to ground that the operators or other persons in the vicinity can not readily touch such parts unless standing on the mats, platforms or insulating floors.

The suitable guarding of live parts by inclosures or barriers effective during attendance or necessary adjustments of live parts will obviate the necessity for insulating mats, and, where such mats are impracticable from the nature of the location or processes carried on, guards shall always be used.

Where connectors are used in motor leads, these should be provided with insulating covering equal to that on the conductors.

(*c*) Where necessary, steps and handrails should be installed on or about large machines to afford safe access to live parts which must be examined or adjusted during operation.

(*d*) Where two or more machines, either of which operates at over 150 volts to ground, are mechanically coupled together, and the operator can touch the frames of more than one at a time, the frames of all such machines shall be permanently grounded, unless they are bonded together electrically and surrounded by insulating mats or platforms on which persons must stand in order to touch the machine frames. If operating at above 300 volts to ground, their frames shall always be grounded and frames shall also be grounded wherever, from the nature of the location or of processes carried on, the use or maintenance of insulating mats or platforms is impracticable. (See Rule 304 *c*.)

344. Protecting Moving Parts.

Suitable guards or inclosures shall be arranged at each motor or motor-driven machine when necessary to prevent persons or objects from inadvertently coming in harmful contact with moving parts, including chains, belts, gears and pulleys.

SECTION 35.—ELECTRIC FURNACES AND WELDERS.

350. Protection from Burns.

(*a*) Electric furnaces and apparatus used for arc welding, where intensely glowing, incandescent, or arcing parts are exposed, shall be inclosed, so that those parts will not be accessible or visible to unauthorized persons.

(*b*) Suitable protecting screens, hoods, goggles, gloves and other devices shall be provided for the authorized operators who must work or come near such exposed parts.

351. Grounding.

The outside non-current-carrying metallic frames of furnaces shall be permanently grounded if they contain current-carrying parts connected to circuits above 150 volts to ground, or if the circuit within is not grounded and is exposed through transformer windings to a circuit over 150 volts to ground.

352. Guarding Live Parts.

Except at points where necessarily left exposed (as at spot-welder contacts) all current-carrying parts of furnaces, welders and control equipment shall be suitably guarded with inclosures or barrier guards.

DISCUSSION OF SECTION 34.

340. Control Devices.

(*a*) The importance of automatic speed-limiting devices for use with certain types of motors and converters is becoming better realized by users. Centrifugal devices are generally used, which operate relays actuating switches in the motor-supply circuits. Motor-generators and rotary converters, when operating in parallel with other direct-current generators, are likely to attain high speeds upon the interruption of the alternating-current supply, due to the reversal of the current in the series-field winding and the consequent weakening of the field under motor action. The characteristics of series motors are also such as to cause them to run at excessively high speeds under light or no-load conditions. Separately excited motors are particularly liable to "run away," since the circuit supplying their excitation may be interrupted while the armature current is maintained. Such loads as direct-connected fans, pumps, or loads of the same character driven through positive mechanical connections, such as are provided by gear or chain drives, which are free from the danger of releasing the motor, due to belts slipping off, obviate the necessity for speed-limiting devices.

(*b*) Frequently motors are provided with field rheostats capable of weakening the field dangerously. The danger of overspeed with excessive resistance in the field circuit may be serious when starting the motor without load. The automatic return of motor starters to the "off" position when energy supply fails (or is cut off by throwing of switch) will prevent severe mechanical strain to the motor and connected machinery and also prevent the operation of "no-voltage" releases on equipment controlling other circuits, which is likely to occur if full voltage, without the resistance or reactance of the starter, is thrown on a motor at rest.

343. Guards for Live Parts.

For low-voltage machines guarding is sometimes accomplished by use of insulating mats. These prevent the most frequent cause of shocks, contact with electrical circuits while standing on grounded surfaces. The somewhat less frequent cause of shocks, touching electrical circuits while in contact with grounded surfaces but not by standing on them, caused by bringing the body in contact with grounded parts while touching live parts, can best be prevented by use of suitable inclosing or barrier guards about the live parts themselves. With motors of utilization equipment this protection should generally be provided wherever dampness or congested space or dangerous processes make insulating mats ineffective, and with utilization equipment of the higher voltages this precaution should generally be taken even in relatively dry and clear spaces.

In some cases insulating screens or covers will be necessary about the exposed grounded parts rather than about live parts, where necessity for frequent adjustment of brushes, commutators, or other live parts makes guarding of such parts difficult. Fortunately, with modern motors such adjustments should be rarely needed, and it becomes simpler where adjustments are needed and permanent guards for live parts are not, therefore, feasible to inclose the motor in a fenced space accessible only to qualified inspectors or repair men. The less rigid rules for stations then apply to such motor installation. (See Rules 123 and 125.)

344. Protecting Moving Parts.

The protection of moving parts of machinery of all kinds is now the subject of many laws and orders for state industrial commissions. The standards of the casualty underwriters also apply in many installations. Since other influences are tending to standardize this subject, the electrical safety rules simply require the provision of suitable guards, leaving detailed requirements to the authorities having jurisdiction.

DISCUSSION OF SECTION 35.

350. Protection from Burns.

The shielding of the eyes and unclothed body surfaces from the intense radiation of any electric furnace or welding process is quite essential and this is usually recognized, although in the past too often only after severe burns and eye strains have been experienced by some employe. The action of an intense arc is to produce burns similar to those caused by the sun, but usually much more severe by reason of the close proximity of the arc. Much has been done by individual firms toward the development of special glass to protect the eyes, and it is not infrequent that a combination of glasses is used, some to cut down the intensity and others the ultra-violet and infra-red rays. The use of a suitable headgear other than goggles sometimes is necessary to protect the face. This often consists of a nonmetallic covering fitting over the head, with openings in front of the eyes fitted with glass, as above described. Some provision is also made for ventilation.

To prevent curious or unauthorized persons from injury by trespassing, or by gazing at the intense light, it is usually necessary to place the processes in a separate room or inclosure, to which no one is admitted without special permit.

351. Grounding.

Where furnaces and welders have exposed noncurrent-carrying metal parts with which the workman must frequently come in contact, and which are exposed also to possible contact with the metal material being handled while such material is in contact with grounded floors, machines, or other such surfaces, these exposed metal parts should, in general, be grounded. The rule requires this grounding where the frame or other noncurrent-carrying metal parts inclose current-carrying parts which exceed 150 volts to ground, on account of the danger of electric shock to workers which then exists in addition to that of severe short circuits which exist also at lower voltages.

Insulating floors which would prevent both dangers are generally impracticable from the nature of the processes or surroundings.

352. Guarding Live Parts.

In most electric furnaces live parts can be readily guarded against accidental contact by persons or materials. The nature of the location and processes makes even low potentials a great menace, as metal material and the large current capacities involved can cause serious short circuits.

For parts over 150 volts to ground, shielding is the more essential on account of the increased shock hazard as voltage increases, and spot welding, requiring bare movable electrodes, should therefore usually be confined to lower voltages

(To be continued.)

ESTIMATING COSTS IN CONTRACTING.

Dangerous Practice for Architects and Their Clients to Accept Very Low Bids.

There was considerable discussion, at a recent meeting of electrical contractors, of methods of estimating jobs before submitting bids therefor. As a rule, the results arrived at by a number of capable estimators as to costs of material and labor may not be far apart for the same job. Of these two elements, the labor costs are subject to the greater variation, depending a good deal on the efficiency and experience of the organization which might undertake the work.

Overhead expense is another element which admits of a considerable range in estimating. Manifestly, an experienced concern, having a number of jobs under contract, would be in position to reduce each individual overhead cost by proportioning the aggregate cost among the several jobs. However, because of overload

costs, another side to this is in evidence when a slump in work comes and the larger concern finds itself with a 100-per cent organization on its hands and with work for only 50 per cent of its capacity. Its overhead, pending a readjustment, may then be abnormally high.

There are also some of the conditions likely to be factors when work is awarded at cost plus a specified per cent for profit.

While the tendency may be to get away from the plan of competitive bids, there will be less objection to it when materials and the prices thereof are so standardized that bids may be submitted on the unit basis, and when labor conditions are in a similar way stabilized. There will always be room for a variation in bids when overhead costs are being figured, and when risks of weather and accident are being computed.

But when a bid on work is submitted at a figure far below that at which the most experienced firms would undertake it, a fair conclusion is that the bidder is either destined to lose money through inexperience at the business, or is figuring on using material and equipment below the recognized standards and doing inferior work. Most architects have had sad experiences when accepting very low bids and will therefore caution their clients against the dangers that may follow from the effort to save a few paltry hundred dollars through an alluringly low bid. Any architect or general building contractor who fails to point out to the owner the hidden dangers lurking in the low bid is untrue to his profession and should be held strictly to account for all troubles resulting from acceptance of bids that are clearly below the cost of doing the work proposed.

SMALL MOTOR AND GENERATOR INSTALLATIONS.

A successful and somewhat novel form of generator stand has been constructed by the science department of St. Louis University. The base of the motor-generator set, illustrated in Fig. 1, is made of 1½-inch iron pipe, with floor plates for bolting to the floor, with double tees at the back, reduced to accommodate 1-inch pipe for the switchboard and control apparatus. Angle iron bolted to the 1-inch standards serves for hanging the rheostat. No wood is used throughout the construction, and all apparatus, even the 5-kilowatt motor-generator set, is bolted to the pipe directly. The bus bars, shown under the rheostat, are held in place by porcelain clamps, partly visible in Fig. 1. A slate slab, used for the switchboard, and upon which are mounted instruments and switches, is also bolted directly to the 1-inch standards. The apparatus is seen to be neat, the arrangement compact and the operation entirely successful.

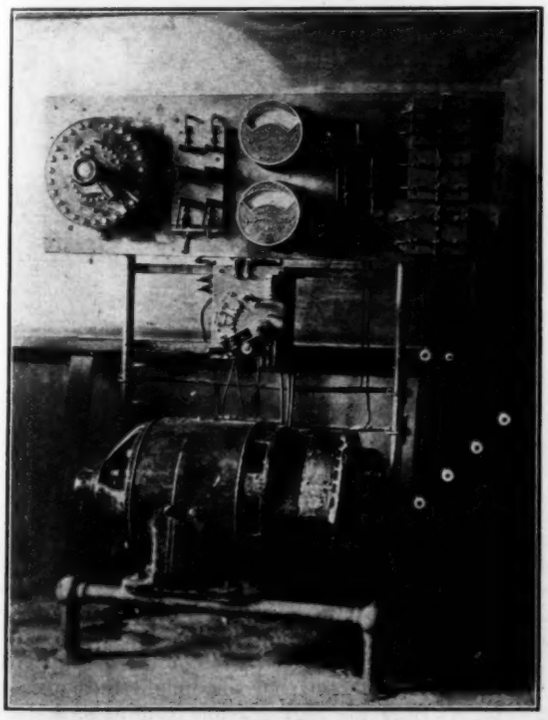


Fig. 1.—Pipe Mounting of Motor-Generator and Switchboard.

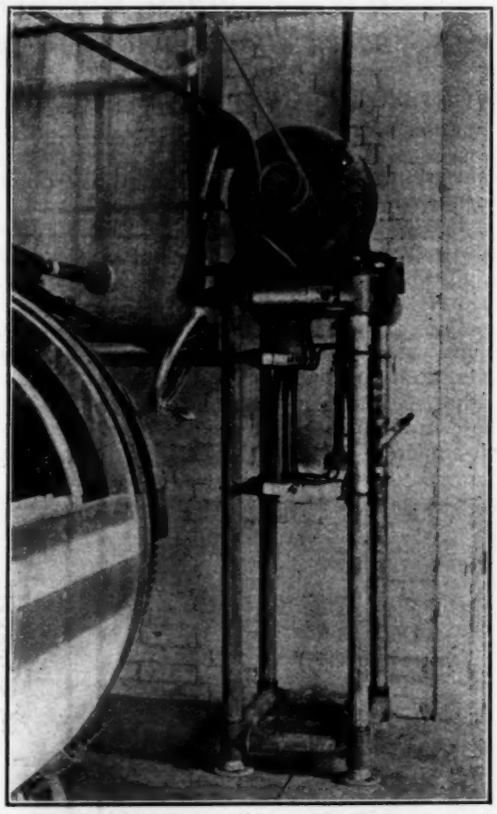


Fig. 2.—Method of Mounting Motor on Pipe Frame Foundation.

Another similar but somewhat different application of the same form of construction for a 10 h. p. Crocker Wheeler motor, is shown in Fig. 2. It was necessary for safety to keep this motor off the floor, yet it was impossible to hang it from the ceiling. A 2-inch iron pipe stand about 5 feet in height was built, therefore, for bolting to both floor and wall. To this the motor base was directly bolted. The space beneath the motor is utilized for bus bars and switch. Because of the short distance between pulley centers and the great difference between pulley diameters, it was necessary to employ an idler. This idler is of pipe, ¾ and ½ inch, built on to the stand. By means of a turn-buckle, idler adjustment is easily made. Pipe stands as described may be entirely free from vibration; they eliminate objectionable wood construction and permit of readily grounding the entire motor frame and base, by one connection between the stand and the conduit, as shown, and may permit floor space to be used to useful purpose.

New Appliances

World's Largest Single-Phase Transformer—Electric Furnace Voltage Control—New Cable End Bell—Other Devices

WORLD'S LARGEST SINGLE-PHASE TRANSFORMERS.

What are probably four of the largest single-phase transformers ever built were recently shipped by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., to a southern power company. These units are rated at 14,000 kilovolt-amperes, 60 cycles, and since they have a 25 per cent overload rating, they are practically 17,500 kilovolt-amperes maximum rated transformers. These transformers will operate at the highest transmission voltage used today, that is, 150,000 volts.

These transformer units will form one 42,000-kilovolt-ampere bank, which, together with a spare unit, will make the preliminary installation to step up the voltage from 13,200—that of the water-wheel generator. Power will be transmitted about 25 miles to an industrial plant where it will be stepped down by means of a number of 7000-kilovolt-ampere single-phase transformers of similar characteristics, ten of which have recently been built by the Westinghouse Company.

Fig. 1.—Construction of Single-Phase Transformer.

Owing to the large size of the units themselves and the great amount of generating capacity which will ultimately be concentrated behind these transformers and their need to be able to withstand the effects of momentary short-circuits, the shell type of transformer with the special end frames and bracing arrangement shown in Fig. 1 was selected. Structural steel for these parts was used throughout because the strength of the various members can be depended upon to a much greater degree of certainty than with castings. The top and bottom ends of the coils are held against distortion by two heavy steel plates and reenforced by four lengths of angle iron riveted to them and held together by four heavy tie-rods.

The tanks are made of heavy boiler plate, all seams being welded by means of the oxy-acetylene process. A structural steel base with wheels supports the tank. The high-tension terminals are of the condenser type, protected by means of a number of porcelain rain shields to adapt them to outdoor service.

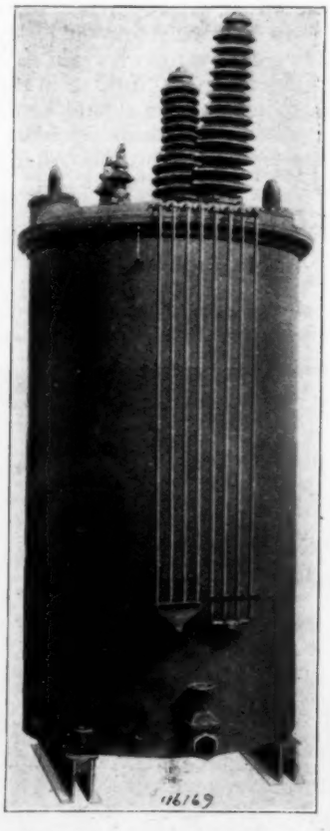


Fig. 2.—One of the Complete Units.

Some idea of the physical size of these units may be gained from the fact that the height measures 23 feet 6 inches over the high-tension terminals, and the

units weigh complete with oil and fittings around 110,000 pounds. Fig. 2 shows the appearance of the completed unit.

ELECTRICAL FURNACES GO TO HIGHER CAPACITIES.

With the advent during the past year of 20-ton electric furnaces and indications of an advance to a standard maximum of 30 tons, the General Electric Company developed an improved system of automatic control to handle the motive power necessitated. These improvements became necessary as the rate of steel production in these furnaces had been increased by the use of higher capacity transformers and higher voltages, which permitted forcing power into the furnaces at considerably higher rates.

The control panel is made in three sections, as shown in Fig. 1. The top section contains three shunt relays and three contractor groups; the total number of each being in accordance with the number of electrodes used. The middle section has three contact-making ammeters each provided with dashpots to prevent hunting, with coils provided with taps which are used to vary the amount of power supplied to the furnace. Beneath are three small dial switches, connected to the coil taps. On the lowest section are four double-pole single-throw knife blade switches with fuses, one switch being used for the line and the others for the electrode motors.

Each contactor group consists of three units, all mechanically interlocked, two contactors being normally open and one being normally closed.

Facing the panel, the left-hand contactor of any group makes the necessary connections to raise the electrode, while the right-hand contactor causes the electrode to be lowered and the bottom contactor short circuits the motor armature through a resistance, in this way dynamically breaking all moving parts and stopping them almost instantly. A higher resistance is connected in circuit with the armature when lowering than when raising, the purpose of which is to keep the speed approximately constant.

A shut-wound electrode motor, which is not shown, is connected to the line until the desired regulation is obtained, when the motor is disconnected and stopped almost instantaneously by means of dynamic braking, this method giving the simplest and most positive control of the electrode movement. The type of motor used was designed for this particular service especially in regard to self-lubricating bearings, and ranges in size from 1 to 1½ horsepower for small equipments to 5 horsepower for 15 to 20-ton furnaces.

The increase in power used can be seen by taking, for example, the 6-ton furnace, which is the size in most general use. The transformer capacity has increased from 900 kilovolt-amperes to 1500 kilovolt-amperes, and even 1800 kilovolt-amperes has been proposed, all these capacities being based on 100 volts. In the variable voltage equipments the successful use of 150 volts renders it possible to increase the normal 1500 kilovolt-amperes up to 2250 kilovolt-amperes.

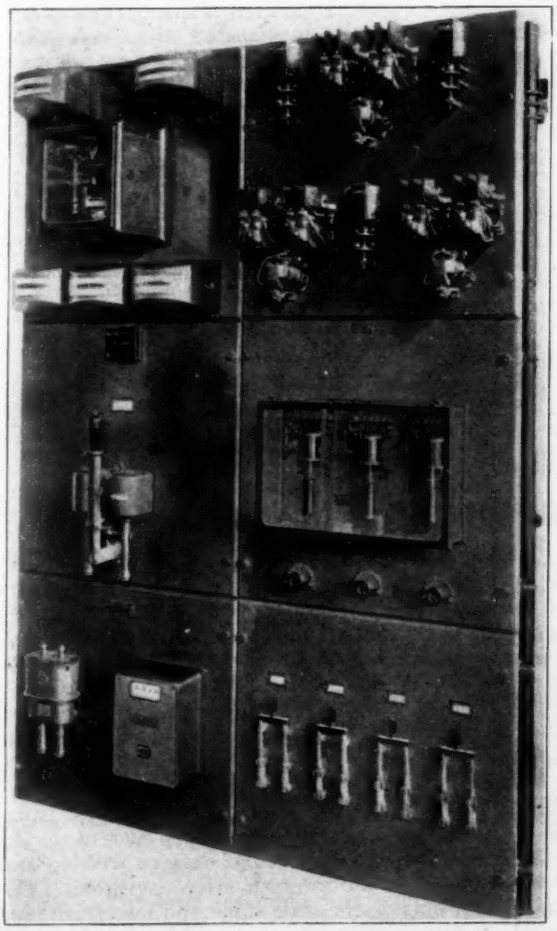


Fig. 1.—Hand and Automatic Control Switchboard for Electric Furnace.

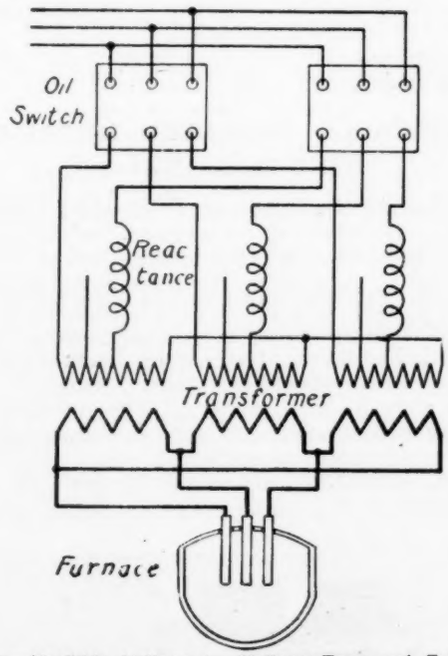


Fig. 2.—Variable Voltage by Voltage Taps and External Rea tance for Use During Melting.

Although 100 volts remains standard for refining, voltages up to 173 have been used for melting, these voltages being obtained either by high voltage taps or high voltage Y-data. When it is considered desirable to use external reactance with the higher voltage taps, the method of using these reactances is shown in Fig. 2.

The use of high voltages during melting down permits of decreasing the current for a given input, improves the power factor and insures higher emergency input when most needed.

NEW FLANGE-TYPE CABLE END BELL.

The Electrical Engineers Equipment Company, of Chicago, has recently made certain improvements in its line of cable end bells, which not only make them more desirable, from a standpoint of installation and operation, but also enables them to be manufactured without any additional cost for these improvements.

The principal improvement consists in a flange, which is cast about the neck of the bell where the lead-covered cable enters the same. This flange is so arranged that adapters for mounting the bell upon any size of conduit, or for any size of clamp or wiped joint to cable can be bolted to this flange.

In case the bell is to be mounted upon conduit, a brass bushing is provided, which is clamped in between the ball flange and the flange upon the pipe adapters. This bushing forms the ground connection.

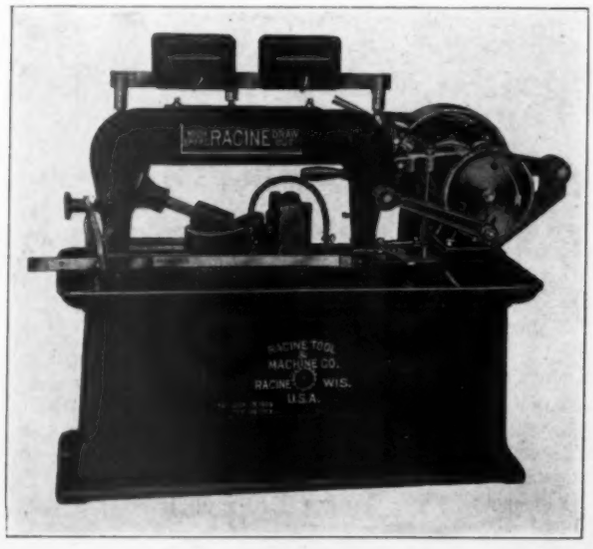
When installing the bell, same can be accomplished without turning it upon the conduit, which was the case when screw fittings were used. This is a particular advantage, especially when the bells are to be installed in limited spaces, where there is not sufficient room to revolve the same.

The use of the flange bell also eliminates the very extensive operation of tapping the bell in its manufacture, therefore enables a superior piece of apparatus to be produced at no additional cost.

All cable end bells of this company's manufacture are being made in this style.

ELECTRICALLY OPERATED METAL-CUTTING MACHINES.

Pursuing the manifold uses of electricity leads one into the works and laboratories of nearly all industries, where the applications of electric power are practically without limit. A visit to the shop and assembling rooms of Racine Tool & Machine Company, Racine, Wis., is of interest because a highly specialized industry is carried on there. Herewith is illustrated a type of high-speed metal-cutting machine, made in three standard sizes by this company. The standard machines are used in shops all over the world, and in addition to this many are made on special order. They have been in great demand during the last four years for cutting steel in munitions plants. Several months ago 1500 of these machines were installed in one factory where 44,000 3¼-inch shells are turned out per day. As a rule the machines are operated in groups from a motor-driven line shaft, each machine requiring ½ to 1 horsepower, according to the size. The speed of the 12-inch pulley shown is about 130 revolutions per minute for cutting mild steel.



Racine Metal-Cutting Machine.

A feature of the operations of the cutting blade is the draw cut and the automatic lift for the return stroke, there being no dragging back of the blade. It is said to be the only machine made that is positive in every action and that will duplicate itself in every cut during life of the machine. That is, it does not vary from accuracy after extended use. All parts are interchangeable and accurately machined.

J. Moores Jones, president of this company, who has given years of study and practice to metal cutting, developed this type of machine. In discussing the subject he states that the basic principle in all manufacturing is in cutting the material used. The shop tools used in the manufacture of these metal-cutting machines are all motor driven. A new Ingersoll milling machine, recently put in position, represents an addition to the shop capacity, which is now equal to 40 machines per day.

NEW HUBBELL ATTACHMENT PLUG.

Harvey Hubbell, Inc., Bridgeport, Conn., has placed on the market a composition motor attachment plug, which is listed as No. 6179.

This plug is designed for use with devices employing small motors such as vacuum cleaners, floor scrubbers and the like. It is constructed of a high-grade, heat-proof composition, measuring assembled, 1⅝ inches in length and 1 1/32 inches in diameter at bottom of base. The portion with contact blades is arranged with holding slots or grooves for fitting into the apparatus and all current-carrying parts of the portable body are carefully concealed within patented arcing chambers to prevent accidental contact.

New Hubbell Motor Attachment Plug.

MOTOR-OPERATED PEANUT ROASTER.

C. Cretors & Company, of Chicago, Ill., have developed a line of motor-operated peanut roasting and corn popping machines of the type used in stores, amusement parks and at sidewalk stands. The revolving parts are turned by a fractional horsepower motor made by the General Electric Company.

By a slightly different arrangement of the heating apparatus either gas or gasoline may be used for the popping or roasting.

A motor suitable for the current supplied is furnished. It may be connected to the nearest lamp socket, for use on alternating or direct current.

Peanuts are now recognized as very nourishing and a food valuable in the interests of consevation. The peanut stand outside the shoe shine and ice cream parlor and at street corners is a form of load to be cultivated by central station companies.

Trade Activities

Anderson Electric Specialty to Enlarge Quarters — Huff Electrostatic Separator Company Opens New York Office

J. D. Barnhill, Inc., with offices located at 110 West Thirty-fourth street, New York City, has changed its name to Dodd-DuBosque Company, Inc.

Driver-Harris Company, manufacturer of wire, strip and strand, Harrison, N. J., recently issued an extensive bulletin on the subject of "Pure Sheet Nickel." Another bulletin on "Nichrome" wire mesh containers for heat treating and acid cleaning has also been prepared and is offered for distribution.

Huff Electrostatic Separator Company, owners and manufacturers of the electrostatic process of ore concentration, has opened an office at 120 Broadway, New York City, for consultation regarding ore-dressing problems, especially the dry concentration of ores and the separation of valuable minerals from others which are commercially detrimental. A. L. Sweetser is the New York representative of the company.

Sorgel Electric Company, Milwaukee, Wis., is preparing to occupy two additional floors on its premises at 138 West Water street. This change is to afford room for additional machinery for repair work to meet an increasing demand. The company's principal line is the repair and installation of electrical machinery, although some specialties are manufactured. On April 1 the company began issuing monthly stock lists and prices of new and second-hand machinery.

Racine Electric Company, Racine, Wis., occupies three floors of a building for carrying on a variety of manufacturing. One feature of its factory work is the manufacture of 110 to 130-volt motors of 1/16 horsepower for use in dentistry, thousands of which are used. Another feature is the making of equipment for barber shops, consisting of 1/16-horsepower motors, flexible shafts, and worm and gear mechanism for attachment to the barber's clippers; and similar mechanism for operating a vibrator, hair drier or fan from the same motor. This equipment is much used and many such outfits are being made.

Anderson Electric Specialty Company, manufacturer of electric lighting specialties, automobile accessories and dental and laboratory appliances, Chicago, will move into its new factory premises at 118-124 South Clinton street on May 1, which will practically treble its present factory capacity. The feature of its line of accessories is the Autoreelite. This is a combination dirigible windshield search light with an automatic reel extension "trouble-light," making it possible to carry the lamp to any part of the car for inspection purposes and obviating the use of separate extension cords or separable parts of any nature. The Anderson Model B-7 Autoreelite is being used on trucks by the Signal Corps of the United States War Department. Leaflet No. 106 describing this product of the Anderson company will be furnished upon request.

National Lamp Works, Cleveland, Ohio, through its engineering department, is distributing Bulletin 34, which deals with country home lighting. A general discussion is given of the generating plant and wiring. Stress is laid upon the fact that satisfactory operation depends to a great extent upon the installation of wire sufficiently large to carry the necessary power without an undesirable voltage drop. A table is given which will facilitate the selection of wire of the proper size. Photographs of actual installations are used to illustrate the lighting of the home. While the discussion of the lighting of the house is thorough, it is not involved with mathematical calculations for which the average owner of a home lighting plant would have little use. With country homes and on farms there are usually several outbuildings to be lighted and a section has been devoted to lighting the horse barn, hog house, garage, silo, etc. A brief description is given of Mazda lamps for country home lighting service. Copies of this bulletin may be obtained upon request from the engineering department of the National Lamp Works, Cleveland, Ohio.

Demand for Motors in Louisville.—There has been a fairly active demand for motors in Louisville, Ky., during the past week, the American Electric Company having received orders for two 100-horsepower motors for the C. C. Mengel & Brother Company, mahogany manufacturer; the Marine Electric Company, 17 motors; a total of 150 horsepower for the Magic-Kellar Soap Company and the James Clark Electric Company, nine motors of 66 horsepower for Palmer & Hardin, furniture manufacturers.

Electric Equipment Company, automobile electricians, Los Angeles, Cal., announces the appointment of the Auto Battery Service Company of Santa Barbara, as an official service station for Westinghouse and Bijur electric starters and for Eiseman magnetos. This appointment practically completes the service stations now operating under the Electric Equipment Company in southern California on electric starter, generator and magneto work, although many more U. S. L. battery service stations will be opened in the near future.

Western Coil & Electrical Company, Racine, Wis., manufactures and puts on the market apparatus and instruments for the application of the violet ray high-frequency current, for use by physicians, or by any individual, in treating various ailments. The outfit is known as the violet ray generator, made by the company in a number of types. These include the "Vi-Ray-O" applicator for surface application, and others for applications to the throat, ear, eye or other parts. To apply the violet ray high-frequency generator one has only to attach the apparatus to an electric lamp socket. Storage batteries are also provided in cases where no electric light connections are available.

Allis-Chalmers Manufacturing Company, Milwaukee, Wis., is distributing a folder calling attention to the great economical saving which may be derived from developing the water powers and increasing the output of those already developed. The folder illustrates some recent work of the company in this field of engineering and shows a number of powerful turbines which have been installed. The Allis-Chalmers company maintains an engineering organization of long standing and broad experience to serve those who are considering the development of water power. This concern furnishes any type of hydroelectric machinery which may be necessary for any particular development. Bulletin 1636-AE contains detailed information concerning this line of product and is particularly valuable to those engaged in the engineering industry. Copies of this publication will be furnished upon request.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has just issued a revision of its catalog 1-A on lightning arresters. After a brief treatment of lightning in general and ground connections, direct current lightning arresters are taken up. These are the familiar MP (multi-path) arresters, and the newer K-3 condenser type arrester. Both of these are designed especially for street railway use. The K-3 arrester contains a spark gap in series with a condenser, of the flat plate unit form having a capacity of one microarad. To protect old equipment, in which the insulation has become weakened with age, the gap should be short circuited, as this prevents the voltage from rising to a point which might endanger the apparatus. With newer equipment, the spark gap should be left open as this insures that the condenser is always discharged and therefore ready to take care of a larger static surge. The electrolytic arresters now include a type provided with sphere gap having horn extensions on the higher voltages, instead of horn gap only. There are a number of additions to the list of accessories and parts for these arresters. Outline drawings with approximate dimensions of Type AK arresters in various settings complete the book, which is of much interest to electrical men having to do with transmission lines for power and railway purposes. Copies may be had on request at any Westinghouse branch office.

Personal

A. D. Mackie Member Liberty Loan Committee—W. T. Price Becomes President P-R Engine Company—Other Changes

CHARLES L. ROCKWELL has succeeded Rockwell & Heigel, electrical contractors and dealers, Kenosha, Wis.

EDWARD A. BULLIS has severed his connection with the Federal Sign System (Electric) of San Francisco to become associated with the Electric Company of Philadelphia.

GUY R. HASTINGS, formerly sales engineer for the National X-Ray Reflector Company, Chicago, has been appointed manager of sales of the Chicago office of that company.

C. M. BREWER, manager of the Richmond division of the Western States Gas & Electric Company, Stockton, Cal., has been re-elected director of the Richmond Chamber of Commerce.

PHILIP STEPHENS, who has been a member of the engineering department of the Rochester Railway & Light Company, Rochester, N. Y., for many years, has resigned to accept a position with the Austin Company, Cleveland, Ohio.

THOMAS E. GRIFFIN, formerly superintendent of the mechanical department of the Dispatch Publishing Company, Pittsburgh, Pa., has been elected treasurer and general manager of the Dickinson Manufacturing Company, Springfield, Mass.

DR. DELOS F. WILCOX, of New York, a well known expert of utilities and franchises, has been retained by the League of New Jersey Municipalities, with headquarters at Jersey City, N. J., to represent the League in its fight against the proposed trolley fare increase from five to seven cents by the Public Service Railway Company.

A. D. MACKIE, general manager of the Springfield Utilities Company, Springfield, Ill., has been appointed a member of the state committee on the Third Liberty Loan for the circulation of literature and general publicity to consumers of electric light, power, gas and telephone service. Mr. Mackie will have oversight of 15 counties in the general Springfield territory.

A. B. MORRISON, JR., has recently accepted a position with the Smith Gas Engineering Company, Dayton, Ohio, as sales engineer. Mr. Morrison was formerly connected with the Fort Wayne Electric Works and the Rathbun-Jones Engineering Company and more recently with the John H. McGowan Company as its Philadelphia representative.

WALDEMAR D. HERRMANN, who for the last two years has served the C. J. Netting Company, Detroit, Mich., as special representative, has become connected with the Holophane Glass Company, and will act as district agent for Michigan, northern Ohio and New York. Mr. Herrmann was for four years special representative of the Johns-Manville Company and also with the Sunlight Company.

J. J. THOMAS, JR., recently became treasurer and auditor of the Macon Railway & Light Company, Macon, Ga., succeeding Richard Ondersluys.

H. W. STEELE, superintendent of the El Reno division of the Oklahoma Gas & Electric Company, has been appointed local chairman of the Military Training Camp Association.

A. PATTERSON, electrical superintendent of the Southwestern Gas & Electric Company, Texarkana, Ark., has been appointed engineer and engineer of overhead construction of the company.

A. J. GATES, formerly connected with the sales department of the General Electric Company, has become associated with the Baker, Rauch & Lang Company, Cleveland, Ohio, handling the sale of industrial trucks.

JOHN A. TRACEY, JR., Jersey City, N. J., has been appointed local manager for the New York Telephone Company, succeeding L. N. Brant, deceased. Mr. Tracy has been connected with the company for the past 14 years.

GEORGE H. GLASS, who for 17 years has been general manager of the Citizens Telephone Company, Pekin, Ill., has tendered his resignation, effective April 1, and will become associated with the Southern Telephone Company, Cuthbert, Ga., as general manager.

GILBERT DUFFY, formerly office manager of the engineering department of the Puget Sound Traction, Light & Power Company, Seattle, Wash., was recently appointed secretary to the manager. He succeeds J. M. Wilmott, who has become sales manager for the coal mines.

H. J. NEWBILL, formerly district manager for the Stantonville Telephone Company, Tupelo, Miss., has been promoted to the position of assistant to W. N. McAnge, Jr., vice-president and general manager of the Allen Telephone Properties. Mr. Newbill will specialize in handling matters pertaining to traffic and will continue to make his headquarters at Tupelo, Miss.

WILLIAM T. PRICE has become president of the P-R Engine Company, Inc., New York City, and second vice-president of the Rathbun-Jones Engineering Company, Toledo, Ohio. Mr. Price recently resigned as manager and chief engineer of the oil engine department of the De La Vergne Machine Company to develop the manufacture of an oil engine of his own design, having established the Price Engine Corporation, under licenses from which the Rathbun-Jones company will manufacture the engine and the P-R company will distribute it. The main office of the latter company is at 110 West 40th street, New York City. In the Price-Rathbun engine a new principle of fuel injection is employed.

R. E. BROWN, manager of the Mankato division of the Northern States Power Company, has been appointed county chairman for the War Savings Stamp campaign in Blue Earth county.

LOUIS A. FERGUSON, vice-president of the Commonwealth Edison Company, Chicago, has been appointed a member of the auxiliary committee of the Capital Issues Committee for the Chicago Federal Reserve District.

G. T. FISHER, formerly associated with the General Gas Light Company as its southern representative, was recently appointed superintendent of the power and light department, Cumberland County Power & Light Company, Portland, Me.

Obituary.

JOHN PORTERFIELD SPARROW, chief engineer of the New York Edison Company, died at his home in Flatbush, Brooklyn, N. Y., on March 18. He was born in Portland, Me., on March 17, 1860. In 1880 he entered the locomotive and marine engine works of the Portland Company as an apprentice and became a toolmaker and erector for that company. In 1888 he entered the employ of the Sprague Electric Company, whom he served for two years as superintendent in charge of electric railways in various parts of the country.

In 1892 Mr. Sparrow joined the construction staff of the Edison General Electric Company and was employed in building lighting and power plants for this concern and the Canadian General Electric Company until 1895, when he joined the staff of the construction department of the Edison Electric Illuminating Company of New York. Three years later he became superintendent of construction, having charge of all of the construction which included the new Waterside Station, which at that time was the largest and most important construction of its kind. He became chief engineer of the New York Edison Company in 1906 having charge of construction and operation, the position he held at the time of his death.

Mr. Sparrow had been an active member of the American Society of Chemical Engineers since 1898. At the time of his death he was chairman of the Committee on Standardization of Flanges and Pipe Fittings, and had just finished the completed report on that subject. He was actively associated with the Association of Edison Illuminating Companies and the National Electric Light Association. Shortly after the United States entered the war he made a number of tests for the Naval Consulting Board in connection with smoke abatement on ships as a protection against submarines. Mr. Sparrow had a charming personality and his optimistic temperament, uniform courtesy and entire absence of contentiousness endeared him to a host of friends.

Recent Patents

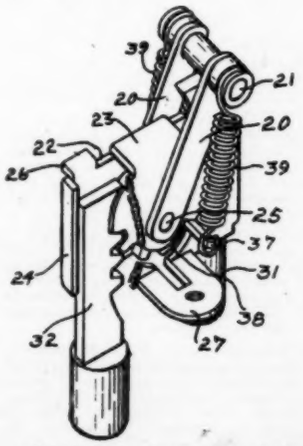
Selected and Summarized by Albert Scheible, Patent Attorney, 79 West Monroe Street, Chicago, Illinois

A series of brief comments on some of the recently issued electrical patents which appear to be of particular interest to our readers, the number after each heading being that of the United States patent to which the summary relates. Any correspondence regarding such patent matters should be sent direct to Mr. Scheible at the above address.

Reduction of Ores (1,256,623).—According to this patent to Siguard Westberg and Emil Edwin, both of Khristiania, Norway, oxide ores are treated with a gas containing as its essentials carbon monoxide and hydrogen heated to a reducing temperature. This gas is obtained by subjecting a carbonaceous combustible material to the action of an electric current in an atmosphere containing carbon dioxide and water vapor.

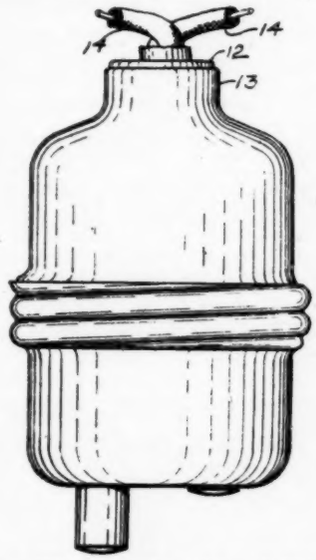
Producing Ammonia (1,256,875).—A mixture of nitrogen and hydrogen is subjected to the simultaneous action of dark discharges and spark discharges in the presence of a catalytic active substance, which substance is disposed on a much greater amount of a carrier of an acid nature. The spark discharges are passed between a metal electrode and a dielectric. Patented by Alexander Classen, of Aachen, Germany.

Extracting Zinc Electrically (1,256,802).—Zinc ore is placed in an electric furnace, along with sufficient carbon to combine into carbon monoxide with the oxygen of the ore, and an electric current is passed through the charge so as to produce various degrees of heat in different parts of the ore. This causes the carbon dioxide formed in the cooler parts of the charge to successively penetrate the hotter parts where the unaltered carbon will reduce it to carbon monoxide. (Patented by Edwin Andreas Johansson, of Trollhaettan, Sweden.)



No. 1,257,534.—Pendant Snap Switch.

Pendant Snap Switch (1,257,534).—By using rack and pinion connections between the push-buttons and the throw-over lever of a double push switch, Joseph Sachs (of Hartford, Conn.) provides a compact pendant form.

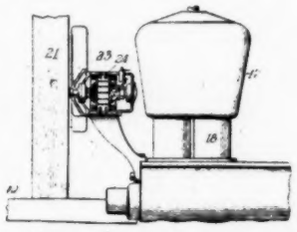


No. 1,257,534.—Pendant Snap Switch.

Making High-Grade Copper (1,257,943).—Copper is precipitated in a finely divided state from a solution of copper salt, and this precipitate is compressed sufficiently to make the particles interlock mechanically, but not sufficiently to give the resulting mass a specific gravity equal to that of cost or rolled copper. The product is said to be of high electrical conductivity and easily worked with tools. The patent was assigned by Wm. H. Howard to Lucy Virginia Howard, of Baltimore, Md.

Wireless Telegraphy and Telephony (1,256,983).—For simultaneously telephoning and telegraphing, Edwin H. Colpitts (of East Orange, N. J.) transmits telephone signals by means of pure modulated waves and destroys the purity of the waves in accordance with telegraph signals. Then the variations in the waves are detected at a receiving station. The patent stands assigned to the Western Electric Co.

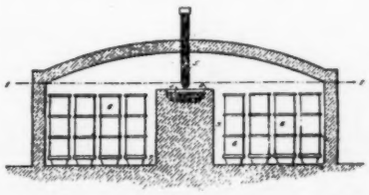
Cooling Fan for Engines (1,259,191).—Under this title, Thomas Zimmerman (of Niagara Falls, N. Y.) has patented a cooling system for engines, consisting of an electric fan driven and controlled independently of the engine. The patent stands assigned to the U. S. Light & Heat Corporation of the same city.



No. 1,259,191.—Engine Cooling Fan.

Winding Phonograph Motors (1,257,286).—This winding device of Joseph W. Jones (assigned to Jones Motrola, Inc., of New York City) consists of an electric motor and a switch for the motor circuit, the switch being automatically closed when the tension of the phonograph spring falls to a given minimum, and opened when the spring has been wound to a given tension.

Alkaline-Battery Plate (1,257,312).—Campbell C. Carpenter makes a positive plate for an alkaline battery by surrounding a nickel wire with alternate layers of a nickel compound and of metallic nickel wire gauze, the result being a cylinder which is compressed by drawing it through a die. The patent stands assigned to the U. S. Light & Heat Corporation, of Niagara Falls, N. Y.



Nos. 1,256,958 and 1,256,959.—Electric Furnace.

Electric Furnaces (1,256,958 and 1,256,959).—Indirect electric heating is employed according to these two patents by Edward E. Walker and John W. Cox, both of Erie, Pa. An arc is struck between a single solid electrode and a liquid placed high up in the furnace, and the heat is reflected by the roof of the furnace against objects or containers surrounding the liquid electrode. In this way, an electric arc furnace can be used for melting brass and other alloys without burning the same.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES.

RUTLAND, VT.—Rutland Railway, Light & Power Company has secured a contract from the Staso Milling Company for supplying additional power to the amount of 717 horsepower for the operation of its plant. The company will also supply additional power amounting to 30 horsepower to the plant of the Ruggles Machine Company.

IPSWICH, MASS.—The water and light commissioners were recently authorized by the town to extend both the water and electric systems.

HARTFORD, CONN.—An opinion has been handed down by the Connecticut Public Utilities Commission granting the Connecticut Traction Company permission to increase its fares from five to six cents, due to increased operating costs, etc. The city of Hartford and neighboring municipalities petitioned the commission to compel the company to re-establish the five-cent rate, charging that the increase was unreasonable. The commission upheld its previous decision.

ALBION, N. Y.—Until April 9, bids will be received by the board of managers of the Western House of Refuge for Women, for the construction of an addition to its boiler plant. Lewis F. Pilcher, state architect, Capitol, Albany. William B. Dye is president of the board.

BINGHAMTON, N. Y. — Binghamton Light, Heat & Power Company has secured contracts for supplying additional power to the plants of the Crandall Stone & Company, the Fairbanks Company, and the Conklin Seed Company, in the amounts of 30, 40, and 17 horsepower, respectively.

BUFFALO, N. Y.—Fower Efficiency Corporation, 102 Clinton street, has filed notice with the Public Service Commission of an increase in its capital from $100,000 to $350,000, to provide for extensions, improvements, etc.

BROOKLYN, N. Y.—Plans are being prepared for the construction of a power plant in connection with the new hospital to be erected by the Beth Moses Hospital at Stuyvesant avenue and Hart street at a cost of about $300,000. Henry J. Nurick, 957 Broadway, Brooklyn, is engineer.

GROTON, N. Y.—Groton Electric Power Corporation is considering plans for the construction of a large power plant at Freeville and a new transmission system covering approximately thirteen miles.

NYACK, N. Y.—Rockland Light & Power Company has filed notice with the Public Service Commission of an increase in its capitalization from $1,000,000 to $1,300,000, to provide for expansion.

POUGHKEEPSIE, N. Y.—Fire at the plant of the Permalife Storage Battery Company, North Road, recently caused a damage of about $10,000.

NEW YORK, N. Y.—Interborough Rapid Transit Company will erect a three-story transformer station, 40x41 feet in size, on the north side of 74th street. Plans have been filed by G. H. Pegram who places the cost at $12,000. Address Horace M. Fisher, general manager, 165 Broadway, New York City.

NIAGARA FALLS, N. Y.—State Reservation Commission, Capitol, Albany, is considering the construction of a large power station on Goat Island, Niagara Falls, which will represent, it is said, an expenditure of approximately $3,000,000. Frank N. Williams, 158 State street, Albany, is State Engineer.

ROCHESTER, N. Y.—Wheeler-Greene Electric Company, 31 St. Paul street, manufacturer of electric motors, etc., which recently filed notice of an increase in its capital from $100,000 to $500,000, is considering plans for extensive additions to its plant to provide for increased capacity.

UTICA, N. Y.—J. & M. Electric Company has filed notice with the Public Service Commission of an increase in its capital from $25,000 to $50,000, to provide for extensions, improvements, etc.

ROCHESTER, N. Y.—M. D. Knowlton Company recently installed 45 additional horsepower electric motors, which will replace a part of the old line shaft drive connected to a steam engine.

BRIDGETON, N. J.—It is probable that the city will own and operate its own electric light plant. Commissioner of Public Works is investigating the cost of installing such a system. It is thought the plant could be established in connection with the water works.

CAMDEN, N. J.—Due to the improved fuel situation, Administrator Staats has issued notice that all exterior advertising illumination will be permitted daily, with the exception of Thursday and Sunday evenings only.

CAPE MAY, N. J. — In connection with the construction of a large group of buildings to be erected by the government, plans have been prepared for a one-story power house, about 36x55 feet in size.

GLOUCESTER, N. J.—Bell Telephone Company, 1631 Arch street, Philadelphia, Pa., has awarded a contract to Albert Zellfelder, 151 South Broad street, Philadelphia, for alterations and improvements in its two-story local telephone exchange plant.

NEWARK, N. J.—Public Service Railway Company has completed negotiations with the Government providing for an extension in its traction system to Port Terminal to provide transportation accommodations to the workers in the shipbuilding and other war plants at this location. It is estimated that the work will cost in the neighborhood of $800,000.

NORTH ARLINGTON, N. J.—Until April 9, bids will be received by the Borough Council for supplying service for the operation of its electric street-lighting system for a period of five years. John H. Shields, Borough Clerk.

TRENTON, N. J.—In connection with the plans under consideration by the city commissioners for the installation of a municipally owned electric lighting and power system, resolutions have been introduced, the first providing that Director of Streets and Public Improvements J. R. Fell be directed to negotiate for a purchase price on the plant of the Trenton Water Power Company, the other resolution providing that E. E. Brownell, the electrical expert, be engaged to estimate the cost of enlarging the pumping station to provide for municipal lighting and other extensive improvements.

HANOVER, PA.—General Gas-Electric Company, which recently filed notice of an increase in its capital to $500,000, has completed the construction of several new additions to its plant to provide for increased capacity.

INDIAN CREEK, PA.—Mountain Water Supply Company has awarded a contract for the construction of its proposed one-story and basement brick and concrete power house, about 30x70 feet in size. Rust Engineering Company, Fennsylvania building, Philadelphia, is the contractor.

LITITZ, PA.—Cottrell Company has been awarded the contract for the installation of electrical equipment in the new fire house being constructed by the fire department on Broad street, at a cost of $13,000.

MONTGOMERY, PA.—Montgomery & Muncy Electric Light, Heat & Power Company has placed into effect a new schedule of rates providing for an increase of 25 cents per lamp for supplying service for the operation of the electric street lighting system of Muncy.

NEW OXFORD, PA.—The council will purchase 5 and 25-horsepower motors for the pumping station.

PHILADELPHIA, PA.—Announcement has been made by the Lehigh Power Securities Corporation, which has power plants at Hauto, Harwood and Allentown, tied together and developing 73,000 kilowatts, that expansion plans are under consideration for extensive additions, for the purpose of working out the central power plant idea to a greater extent in the Lehigh Valley.

PHILADELPHIA, PA.—A new schedule of gas rates, to become effective April 12, has been filed with the Public Service Commission by the Philadelphia Suburban Gas & Electric Company for supplying service in Coatesville. The new rates cover an increase of 25 cents per 1000 cubic feet in unit rates, with a discount of 10 per cent for prompt payment of bills.

PHILADELPHIA, PA.—Quaker City Iron Works, Tioga and Richmond streets, has awarded a contract for the construction of a boiler plant addition at Edgemont and Tioga streets.

PITTSBURGH, PA.—Arrott Estate, Arrott building, has awarded a contract for the reconstruction of its power building on Barker Place recently destroyed by fire. The new structure is estimated to cost $15,000. Rose & Fisher, 821 Penn avenue, Pittsburgh, are the contractors.

PITTSBURGH, PA. — Westinghouse Electric & Manufacturing Company has leased the plant of the Baxter Stove Company, Mansfield, Ohio, for the purpose of establishing this plant as the headquarters for the manufacture of its heating appliances.

READING, PA.—Reading Transit & Light Company has completed the dismantling of the plant at Collegeville formerly used as a power station. The company is planning to use the property as a substation. The firm of Henry Potts & Company, Real Estate Trust building, Philadelphia, purchased the greater part of the electrical equipment of this plant.

STEELTON, PA.—Operations have been inaugurated in the new boiler plant of the Bethlehem Steel Company located near Swatara street. Four new 250-horsepower boilers have been placed in operation. At the present time the company is experimenting on a process for the softening of water used in its boilers.

BOWERS, DEL.—A company is being organized for the construction of an electric light plant and the installation of light throughout the town.

NORFOLK, VA.—Plans for additions to the Norfolk navy yards have been prepared. These consist of a new pattern shop at a cost of $600,000 and a power plant to cost $575,000 and auxiliary structures.

KINGWOOD, W. VA.—Inland Fuel Company, Greensburg, Pa., which recently acquired the plant of the Central West Coal Company, Kingwood, is planning for extensive improvements to cost about $75,000, including the erection of a large power plant.

NEWELL, W. VA.—Novelty Clay Forming Company, manufacturer of electric porcelain specialties, has leased the plant formerly occupied by the Ohio China Company, East Palestine, Ohio, and is planning to remove its works to this location.

FOREST CITY, N. C.—Alexander Manufacturing Company, recently organized with a capital of $200,000, is planning for the installation of new electrically-driven equipment in its proposed new factory building.

PINE LEVEL, N. C.—Citizens Power & Light Company will construct 13 miles of electric transmission system containing two towns of 2500 and 5000 population and build a substation in each town. Address C. S. Goodwin.

CHARLESTON, S. C.—Charleston Consolidated Railway & Lighting Company will install a turbine at power house and extend its facilities. Address general manager.

ELBERTON, GA.—The city contemplates the extension of its electric light system. Address P. M. Hawes.

METTER, GA.—The council is planning to expend $3500 in improving the electric light plant. Address the mayor.

TY TY, GA.—Bonds to the amount of $7000 have been voted to build an electric light plant.

GREENVILLE, FLA.—City council has ordered an election for May 7 upon the issuance of bonds for building waterworks system and possibly for the establishment of an electric light plant.

TAMPA, FLA.—Tampa Electric Company has been authorized to extend its car line on 22nd street and also on Chapin street. Address C. F. W. Weterer, manager.

WAUCHULA, FLA.—Wauchula Light & Power Company is in the market for direct connected unit 2300-volt, 3-phase, 60-cycle revolving field generator of 35 to 40 kilowatts direct connected to automatic steam engine, complete with exciter and switchboard for installation at Bowling Green, Fla.

NORTH CENTRAL STATES.

CLEVELAND, OHIO.—Cleveland Electric Illuminating Company will erect a two-story addition to its switch house, 35x168 feet in size. Electric switches, generators, etc., will be purchased. The contract will be let by F. Hansel, architect, 408 Illuminating building.

HICKSVILLE, OHIO.—A petition is being circulated to secure a new lighting system. Address clerk.

LUCKEY, OHIO.—Power & Light Company has been organized. William Aspacher is secretary.

ATTICA, IND.—The Indiana Public Service Commission has authorized the Attica Electric & Power Company to issue $50,000 in stock and $50,000 in bonds for a new electric light and power plant to take the place of the city owned power house recently destroyed by fire. Attica has a bonded indebtedness of a size which would not permit of more borrowing and hence a private company has been organized. It will manufacture electric power and the city distributing plant will distribute it to consumers.

INDIANA HARBOR, IND. — Chicago, Lake Shore & South Bend Railway Company may extend its car facilities to that section of the city north of the canal. Address Charles D. Emmons, general manager, 102 North Michigan avenue, Chicago.

JEFFERSONVILLE, IND.—The Indiana Public Service Commission will conduct a hearing April 15, 16 and 17 on petition of the Louisville & Southern Indiana Traction Company for changes in rates and schedules on city cars and increases of rates on interurban cars.

LAPORTE, IND.—Laporte Gas & Electric Company has filed a petition with the Indiana Public Service Commission for increased rates for both electricity and gas in Laporte; for higher rates for both electricity and gas in Laporte; for higher rates for electric power and lighting in Westville and on the line between Laporte and Westville.

FRANKFORT, MICH.—The city has voted $5000 bonds to improve its water supply, which will now be pumped by electric motors instead of old steam pumps.

PESHTIGO, WIS.—T. A. Pamperin has purchased the Peshtigo power plant. Additional power will be secured by the erection of a new dam and the purchase of additional equipment.

CROSBY, MINN. — Citizens recently voted $76,000 in bonds for water, light and power systems.

LIBERAL, KANS.—The council has under consideration the installation of a modern street lighting system using iron posts and cluster lights. Address the clerk.

PLAINVILLE, KANS.—United Telephone Company has had plans prepared for the construction of a two-story and basement local telephone building, about 30x75 feet in size, to cost $15,000. H. B. Winter, Manhattan, is architect.

DATES AHEAD.

Tri-State Water & Light Association. Annual meeting, Charlotte, N. C., April, 1918. Secretary-Treasurer, W. F. Steiglitz, Columbia, S. C.

Southwestern Electrical & Gas Association. Annual convention, Galvez Hotel, Galveston, Tex., April 15-16. Secretary, H. S. Cooper, 405 Slaughter building, Dallas, Texas.

American Association of Engineers. Annual meeting, May 14, 1918. Secretary-Treasurer, A. H. Krom, 29 South La Salle street, Chicago.

Arkansas Association of Public Utility Operation. Annual convention, Arlington Hotel, Hot Springs, Ark., May 21-22-23. Secretary-Treasurer, R. B. Fowles, Pine Bluff, Ark.

Electrical Supply Jobbers' Association. Annual meeting, Homestead Hotel, Hot Springs, Va., May 28-30. Secretary, Franklin Overbaugh, 411 South Clinton street, Chicago.

Electrical Contractors Association of Georgia. Annual meeting, Tybee Island, Ga., June, 1918. Secretary, Dan Carey, 614 Chamber of Commerce building, Atlanta, Ga.

National Electrical Credit Association. Annual meeting, June 1, 1918. Secretary, Frederic P. Vose, 1350 Marquette building, Chicago, Ill.

Texas State Association of Electrical Contractors. Annual meeting, Galveston, Tex., June 15, 1918. Secretary, H. S. Ashley, Fort Worth, Tex.

Southeastern Section, National Electric Light Association. Annual meeting, June 19-20, 1918, Atlanta, Ga. Secretary-Treasurer, T. W. Peters, Columbus, Ga.

American Institute of Chemical Engineers. Summer meeting, Berlin, N. H., June 19-22. Headquarters, Mt. Madison House, Gorham, N. H. Secretary, John C. Olsen, Brooklyn, N. Y.

Northwest Electric Light & Power Association; affiliated with N. E. L. A. Annual meeting, September 11, 1918. Secretary, George L. Myers, Pacific Power & Light Company, Portland, Ore.

SOUTH CENTRAL STATES.

BIRMINGHAM, ALA.—Tennessee Coal, Iron & Railroad Company will open a coal mine in the Blue Creek region and will install electric equipment. A turbogenerator will also be installed in the power station of its blast furnace at Ensley.

CHICKASAW, ALA.—In connection with its shipbuilding project estimated to cost about $10,000,000, the Chickasaw Shipbuilding Company is planning for the construction of a large electric generating station at a cost said to be in the neighborhood of $750,000. J. F. Coleman is general superintendent.

MOBILE, ALA.—Chickasaw Shipbuilding Company will establish an electric light and power plant which will involve the expenditure of $750,000.

CRYSTAL SPRINGS, MISS.—The city is planning for the installation of new equipment in its electric light plant to cost about $5000.

BUFFALO, ARK.—Plans are under consideration by the Dixie Girl Mining Company for the installation of a new electric light plant at its properties. A. C. Barnhart is construction engineer.

DELIGHT, ARK.—A franchise for an electric light plant has been granted to B. F. Ryan of Texarkana, who will begin erection of the plant at once.

HELENA, ARK.—Helena Gas & Electric Company, which recently filed notice of an increase in its capital from $300,000 to $500,000, is considering the construction of new additions to its plant and the installation of new equipment.

JENNINGS, LA.—City will vote on bonds to construct an electric light plant, ice factory and sewer system. Address the mayor.

SHREVEPORT, LA.—Elliott Electric Company has had plans prepared for the construction of a large local plant to be devoted to the manufacture of electric fuses. It is expected that the works will have a daily capacity of 10,000 electric lighting and power fuses, and 15,000 automobile fuses.

GUYMON, OKLA.—Benham Engineering Company, Oklahoma City, Okla., engineers, has completed appraisal on the electric light plant and waterworks system. Address Guymon Electric Light & Power Company.

HOMINY, OKLA.—Hominy Ice, Light & Power Company is planning for the immediate installation of new equipment in its power plant, including a new 150 horsepower gas engine direct connected to a 100-kilovolt, 3-phase, 60-cycle, 2300-volt generator.

SHATTUCK, OKLA.—Plans are under consideration by the city for the construction of an addition to its power house and other improvements, to cost about $25,000. Burns & McDonnell, Kansas City, Mo., are engineers.

FERRY, OKLA.—Election will probably be called soon to vote bonds for improvement of waterworks and electric light system.

BOWIE, TEX.—The city will issue $15,000 bonds for electric light plant. Address T. C. Phillips.

DALLAS, TEX.—Texas Power & Light Company and the Dallas Power & Light Company are jointly constructing a high tension line to connect the two power systems. This will enable an interchange of power between the two companies.

McKINNEY, TEX.—Texas Light & Power Company is planning for the immediate reconstruction of its electric lighting plant recently destroyed by fire with loss estimated at $8000.

TEXAS CITY, TEX.—The Texas City Electric Light & Water Company will build an electric light and power plant here. The building in which the machinery and equipment will be installed will be of concrete and brick construction. The machinery will consist of a 100-kilowatt turbogenerator with a converter for the street car service and an emergency lighting set. Heretofore the Texas City Electric Light & Water Company has bought its current from the Texas City Terminal company, which operates a power plant here.

WESTERN STATES.

HARLEM, MONT.—Contract for installing lighting system here was awarded to Electric Construction Company of St. Paul at $4550.

MANVILLE, WYO.—Manville contemplates the installation of a new electric light plant to cost $30,000.

WHEATLAND, WYO.—Bids have been received by the council for the new engine and generator to be purchased for the power plant. An inner combustion fuel oil engine of 150 horsepower was selected and a 120-kilowatt generator with a direct connection. A new switchboard, which will be synchronized with the present one, will also be installed. A brick addition to the present plant will be constructed to house the new machinery.

COLUMBUS, N. M.—Columbus Electric Light & Power Company has under advisement the construction of an electric light and power plant for supplying electricity in Columbus and Camp Furlong. The proposed is estimated to cost approximately $30,000.

BREMERTON, WASH.—Bureau of Yards and Docks is preparing plans for construction of four magazine buildings, four shell houses and two 2-story warehouses. Specifications also call for installation of two turbogenerators at an estimated cost of $90,000.

SEATTLE, WASH.—Pacific States Electric Company, 570 First avenue, South Seattle, recently closed a contract for supplying all the electrical supplies to be used in the 20 3500-ton Ferris type wooden boats now being constructed by the Sloan Shipyards Corporation at Olympia.

SPOKANE, WASH.—Issuance of $40,000 in bonds was recently authorized by the Loon Lake Copper Company, proceeds to be used in constructing a mill and equipping a mine four miles from Loon Lake, Washington. All equipment will be operated by electric motors. Frank G. Crane is the secretary-treasurer of the company.

NORTH BAY, ONT.—The Hydroelectric Power Commission has under consideration the installation of a storage dam at Cox Chute on the South river for the Nipissing System.

PERTH, ONT.—The town contemplates the remodeling of its street lighting and distribution system and will change from 133 to 60 cycles.

FOREIGN TRADE

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number given.]

ELECTRICAL SUPPLIES (26,693).—A company in South Africa is in the market for electrical supplies. Catalogs and full information should be submitted forthwith.

ELECTRIC LAMP MACHINERY (26,628).—A company in England wishes to buy up-to-date electric lamp machinery. Quotations should be made f. o. b. New York. Payment will be made by cash against documents. Catalogs should be submitted.

ELECTRIC MACHINES (No. 26,671).—The president of the board of public works of a city in Italy wishes to be placed in communication with American firms which could furnish electrical machines for unloading ships and especially for discharging coal and grain. Correspondence regarding this may be written in English.

PROPOSALS

ELECTRIC ELEVATOR.—Bids will be received at the Office of the General Purchasing Officer, Panama Canal, Washington, D. C., until April 11, for furnishing an electric elevator by steamer, free of all charges, on dock at either Colon (Atlantic port) or port of Ancon (Balboa, Canal Zone) (Pacific port) Isthmus of Panama. Circular No. 1208.

MOTORS.—Bids will be received by the City of Chicago until April 8 for furnishing and delivering electric motors at the municipal reduction plant, according to plans and specifications on file at the office of the Department of Public Works, Room 406 City Hall. Frank I. Bennett, Commissioner of Public Works.

ELECTRIC EQUIPMENT FOR POWER PLANT.—Bids will be received April 8 by the Power Plant Equipment Bureau of Yards and Docks, Navy Department, for electric equipment for power plant at Norfolk and Philadelphia, located at Norfik and Philadelphia, respectively.

ELECTRIC SUPPLIES.——Bids will be received by the navy purchasing office in or near to each navy yard mentioned below for the following electrical material: 13 water-tight annunciators, a miscellaneous number of vibrating water-tight bells and non-water tight buzzers, 160-12 x12, ¾ to 1⅛ inches thick carbon plate, 540 pounds pressed plate mica, 18x36 inches, 100 pounds India select uncut mica, 700 pounds soldering electric non-acid paste, 2000 attachment plugs, 15 rheostats for motor field, 80 pounds hard, rod sheet rubber, 30 portable ventilating sets, 600 keyless brass sockets, 1500 pull sockets, 356 knife switches, 900 snap, water-tight switches, a miscellaneous quantity of No. 10, ¾-inch wide insulating tape, 400 crowfoot zincs for delivery at the Mare Island (Cal.) navy yard. Schedule 1707; 250 conduletes with wire porcelain covers, 3200 solid porcelain knobs, 2300 porcelain receptacles to be delivered on Schedule 1705 at Mare Island (Cal.) navy yard; two 1000 cubic feet ventilating sets for hull ventilation on Schedule 1706 for delivery at the navy yard at Mare Island, Cal.; and 500 fire control telephones on Schedule 1717 to be delivered at the Philadelphia navy yard.

ELECTRICAL EQUIPMENT.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 8 for furnishing and installing exciters, switchboards, cell structures, cell equipment, wiring, transformers and other miscellaneous electrical power-plant equipment in the power plants at the navy yards, Norfolk, Va., and Philadelphia, Pa. Refer to Specifications No. 2762.

INCORPORATIONS

CHATTANOOGA, TENN. — Southern Cities Power Company was recently incorporated with a capital of $50,000. The incorporators are George B. Adams, J. C. Stickney, G. W. Erwin and others.

NEWCASTLE, IND.—Home Lighting & Storage Battery Company has been incorporated with capital of $25,000 by Samuel M. Denton, Luther O. Draper and Isaac E. Hays. The business of the company will be to manufacture storage batteries for automobiles.

OLCOTT, W. VA.—Kanawha Central Power Company. Capital, $100,000. To operate a local plant. Incorporators: S. B. Avis, I. C. Jordan, and N. F. Young.

NASHVILLE, TENN. — Cumberland Power Company. Capital, $100,000. To operate a plant for the generation and distribution of electricity. Incorporators: K. E. Longfield, M. L. Horty, and F. D. Buck, Wilmington, Del.

GETTYSBURG Pa. — Automatic Changeable Electric Sign Company. Nominal capital, $5000. To manufacture electric signs. H. L. Snyder is treasurer.

UNIONTOWN, PA.—Measured Service Meter Company. Capital, $50,000. To manufacture telephone meters. A. R. Neville is the principal incorporator.

DOVER, DEL.—Commonwealth Public Service Company. Capital, $500,000. To operate a plant for the generation and distribution of electricity. Incorporators: M. M. Clancy, C. L. Rimlinger, and F. A. Armstrong, Wilmington.

SOUDERTON, PA.—Hilltown, Hatfield Township and the Franconia Electric Light & Power Company. Capital, $5000 each. F. S. Muzzey, Mt. Airy, is the principal incorporator.

BUFFALO, N. Y.—Dynamo & Motor Exchange, Inc. Capital, $10,000. To deal in dynamos, electrical equipment, etc. Incorporators: Frank J. Martin, John H. Farrell, and Albert J. Bissonette, 314 Wyoming avenue.

UTICA, N. Y.—Collite Company. Capital, $100,000, has incorporated to manufacture electrical and gas fixtures. Incorporators: W. I. Taber, W. L. Foley, and S. Garfunkel, Utica.

NEW YORK, N. Y.—Liberty Lighting Company. Nominal capital, $5000. To engage in the manufacture of electrical fixtures, etc. Incorporators: A. Weiss, M. P. Hartman, and H. Hoffman, 2270 Seventh avenue.

NEW YORK, N. Y.—James F. Lynch Company. Capital, $10,000. To engage as electrical contractors. Incorporators: C. P. and N. F. Lynch, and J. A. Kennedy, 621 Faile street.

NEW YORK, N. Y.—Hydro Peller Power Company. Capital, $20,000. To manufacture electrical specialties. Incorporators: J. A. Turner, G. J. Koch, and H. S. Hecheimer, 220 West Forty-second street.

TOLEDO, OHIO.—Toledo Bissell Manufacturing Company has incorporated to deal in vacuum cleaners, electric motors, etc. The incorporators are Frederick Bissell, W. S. Bissell, Ralph S. Halbrock, E. B. Terry, and S. E. Yates. The new concern is capitalized at $10,000.

HAVRE DE GRACE, MD.—Havre de Grace-Taneytown Electric Railway Company has incorporated. The proposed line will extend from Havre de Grace, via Towson, Finksburg and Westminster to Taneytown, a distance of about 65 miles. Address C. Stanley Stirling, Baltimore.

SOUDERTON, PA.—Franconia Electric Light & Power Company was recently incorporated with a capital of $5000 by F. S. Muzzey.

GETTYSBURG, PA. — Automatic Changeable Electric Sign Company has incorporated for $5000. H. L. Snyder.

NASHVILLE, TENN. — Cumberland Power Company was recently incorporated with a capital of $100,000. F. D. Buck, M. L. Borty and K. E. Longfield are the incorporators.

CHICAGO, ILL.—Dayton Power Company of Illinois has incorporated with a capital stock of $50,000, by Charles P. Megan and others.

NEW PUBLICATIONS

COMPARATIVE TESTS OF SIX SIZES OF ILLINOIS COAL ON A MIKADO LOCOMOTIVE.—Bulletin No. 101 by E. C. Schmidt, J. M. Snodgrass, and O. S. Beyer, Jr., Engineering Experiment Station, University of Illinois, tells of a series of tests conducted by the Engineering Experiment Station of the University of Illinois under a co-operative agreement with the International Railway Fuel Association and the Bureau of Mines, to determine the value of different sizes of coal burnt by a Mikado locomotive weighing 140 tons and belonging to the B. & O. R. R.

Until recently nearly all coal used on locomotives was mine-run—the entire unscreened product of the mines. In the past few years, however, increasing quantities of screened lump coal have been used in locomotive service. This increase in the consumption of lump coal has been due partly to the belief that lump coal, when burned on a locomotive, produces enough more steam than mine-run coal to compensate for its greater cost. Special considerations, such as the desire to lessen the amount of smoke formed, have also led in some instances to the use of lump coal, which is generally believed to require less skill in firing than mine-run coal. The introduction of the mechanical stokers for locomotives has resulted in the use of increasing amounts of various sizes of screenings. Thus far there has been little use of such sizes as egg, egg-run, and nut coal on locomotives, although traffic and market conditions occasionally make it feasible and desirable to use them.

The relative values of several sizes of coal for locomotive use have not been well understood since most laboratory and road tests have been made with mine-run or occasionally with lump coal, and the data are inadequate and conflicting, hence the data recorded in this bulletin should be of considerable value. Copies may be had without charge by addressing the Engineering Experiment Station, Urbana, Illinois.

EMPIRICAL METHOD OF ANALYSIS OF CQAL.—The Pennsylvania State College recently issued a bulletin reprinted from its annual report for 1914-15. This publication is divided into two distinct parts, the first of which deals with the Empirical Method for Determining the Ultimate From the Proximate Analysis of Coal, prepared by J. P. Calderwood, associate professor of mechanical engineering. The author tells of the need of such a method and gives a comparison of proximate and ultimate analysis. It takes up the derivation of empirical formulae, showing the relation between oxygen of the ultimate and known terms of the proximate analysis, relation between nitrogen of the ultimate analysis to known terms, adjustment of the calculated values of the ultimate analysis to satisfy the rigid condition and contains detailed information as the results derived from the use of the empirical equations and methods. The second section deals with Tests Showing the Effect of Using Dry and Wet Coal As Fired in a Low-Pressure Steam-Heating Boiler by J. J. Light, and is a reprint of Bulletin 22 of the Engineering Experiment Station. The tests were run in a low pressure steam-heating furnace, manufactured by the American Radiator Company.

COAL: THE RESOURCE AND ITS FULL UTILIZATION.—The Smithsonian Institution of the United States National Museum has published Bulletin 102, Part 4, by Chester G. Gilbert and Joseph E. Pogue, of the Division of Mineral Technology, United States National Museum. This paper deals with the sources of energy which underlie the employment of coal and aims to present a constructive analysis of the fuel situation in the United States. The Bulletin contains much valuable information regarding the production of coal, its uses, how the wastes in mining and distribution may be reduced and the wastes in utilization done away with by the establishment of a method of separating the energy-producing constituents of coal from the commodity values and using the products to their common advantage.

Financial News

San Joaquin Power Bonds.

The Railroad Commission recently issued an order authorizing the San Joaquin Light & Power Corporation to issue $767,000 6 per cent first and refunding bonds, payable in 1950. They are to be sold at not less than 90 per cent of their face value, the proceeds of which are to be deposited in a special fund to be expended at the discretion of the Commission. The money is needed, the company states, to buy property, construct, expand and improve its facilities and service, and is to be spent from time to time as liabilities are incurred. The company has adopted the policy of providing for only 75 per cent of these expenditures by bonds instead of issuing bonds to provide funds for paying 85 per cent of the cost of additions and betterments. In general, the 1918 construction program of the company calls for the installation of a hydroelectric plant at its Crane Valley dam, also a plant at its No. 1 reservoir, and the erection of a building of a six-inch natural gas transmission line to connect its Bakersfield steam generating plant with the Midway Gas Company's natural gas line from Midway oil fields to Los Angeles. Also, preliminary work on its new proposed hydroelectric plants on the San Joaquin river and the North Fork of Kings river, the completion of the transmission lines, substations, and the construction of distribution lines to take care of new business.

New York Utility Notes Offered.

William Salomon & Company is offering subject to prior sale, $1,300,000 two-year secured 6 per cent convertible gold notes of the Niagara, Lockport & Ontario Power Company, authorized by the New York State Public Service Commission, Second District. These notes are selling at 97 and will yield about 7.80 per cent. They are redeemable at par with interest payable on the first day of any month and convertible into new refunding mortgage 6 per cent bonds at 90. As to security, the president of the company states that $2,495,000 mortgage bonds, including $455,000 Salmon River Power Company first 5s, $60,000 Niagara & Erie Power Company first 5s and $1,980,000 new refunding mortgage 6s, have been secured by pledges. The cash investment in the properties, over and above the outstanding underlying bonds, exceeds $5,000,000 or fully four times the note issue. The total income for 1917 after deducting taxes, rentals and interest on underlying bonds, leaves a balance of approximately $352,000, or about four and one-half times the annual note interest. The company has witnessed a growth of 75 per cent in gross sales and over 100 per cent in net earnings since 1912.

Indiana Power Bonds Authorized.

Indiana Power & Water Company has been authorized by the Indiana Public Service Commission to issue $210,000 in capital stock at par and $725,000 in 6 per cent bonds at 85, to be used for extensions of the central electric power plant at Edwardsport. The company has contracts to supply power to a number of coal mines. For 1918 it is proposed to build distributing systems in seven towns. The company now has property interests in Daviess, Knox, Pike, Greene and Sullivan counties. In its petition for authority to issue stocks and bonds the company said it would be necessary to spend $884,924 soon, most of it for transmission lines and power plants.

Colorado Power Sells Stock.

Colorado Power Company has sold to Honbright & Company, $250,000 7 per cent cumulative preferred stock. The proceeds from the sale will be used to pay for additions and extensions already constructed and for the erection of a modern steam station on the company's Sterling property. Installation of electric furnaces for smelting tungsten, manganese and chrome ores in its territory, and new developments in the mining and reduction of ores containing molybdenum in which electric power is extensively used has made increasing demands for current.

Tennessee Copper Votes First Dividend.

Directors of the Tennessee Copper & Chemical Corporation has declared a dividend of $1 a share on the 289,215 shares (no par value) of stock outstanding, payable May 15 to stockholders of record April 30. This is the first dividend announced by the company since the financial readjustment of the old Tennessee Copper company.

Commonwealth Power Earnings Show Decrease.

Earnings of the Commonwealth Power, Railway and Light Company in February continued to suffer from war and weather conditions. Gross revenue increased 5.78 per cent, compared with the same month of 1917, but net earnings decreased 17.59 per cent. The latter amounted to $570,060 and came $14,144 short of meeting fixed charges. After the month's proportionate allowance for preferred dividends the deficit was $103,909. The deficit for the first two months of 1917 after preferred dividends amounted to $279,986. For the year ended February 28, 1918, however, the company reports a surplus of $1,618,454 over fixed charges, and of $541,254 over preferred dividends.

Northern States Dividends.

The regular quarterly dividend of 1¾ per cent on the preferred stock of Northern States Power Company, payable April 20, was declared by the board of directors at a meeting March 27. Dividends on this preferred stock have been paid continuously since organization in 1910. Net earnings, after payment of fixed charges, for the year 1917, were 1.83 times preferred stock dividend requirements. In view of the increased operating costs of the past winter, caused by the extraordinarily increased cost of coal, and also towards conserving cash resources in the interests of essential construction, the board of directors decided not to declare a dividend on the common stock at this time. Dividends have been paid on the common stock since July, 1916.

The company has rapidly increased its business, and is taking on a large amount of additional power load. While operating cost conditions are improving, the service rates have been advanced, the directors are committed to a conservative dividend policy. Financing for the company's 1918 construction program is being satisfactorily arranged. Additions and extensions have been reduced to those absolutely necessary, including the installation of a 32,000-horsepower steam turbine generating unit at the Riverside Station, Minneapolis.

Westinghouse Air Brake Promised Big Year.

Despite the unsettled conditions now prevailing, indications are that the Westinghouse Air Brake Company, Pittsburgh, Pa., will receive large returns on its operations for the year ending July 31, and prospects are strong that the company will have the second biggest year in its history. It has been stated that in all probability the net profits of the company will not fall below $7,000,000 on the present $28,868,000 capital stock. Some estimates have run higher than this, but if a balance of $7,000,000 after local and federal taxes is attained, it would mean profits of 25 per cent against 28.6 per cent on an average of about $20,000,000 capital during the year 1917 and 47.85 per cent in the record year 1916 when $19,638,000 stock was outstanding. The Westinghouse company has been through a considerable strain in absorbing the Union Switch & Signal Company and then had the main producing plant of that company destroyed before the merger was fully completed. In addition to a record volume of signal orders on hand this portion of the company has a $25,000,000 government munition contract which will be finished this year. The Westinghouse Air Brake Company has no bonded or floating debt and has a working capital equal to over 50 per cent on its stock.

Union Gas & Electric Bonds.

The Union Gas & Electric Company, of Cincinnati, has been granted permission by Ohio Public Utilities Commission to issue $2,550,000 bonds in order to finance certain improvements. The company is a subsidiary of the Columbia Gas & Electric Company.

Copper Worth Half a Billion.

Copper valued at more than half a billion dollars was produced in the United States in 1917. Production was slightly less than in 1916, the Geological Survey states. Stocks of refined copper at the beginning of 1917 were about 128,000,000 pounds, making the year's available supply, exclusive of secondary copper, about 2,490,000,000 pounds.

Dividends.

Manufacturers' Light & Heat Company has declared the regular quarterly dividend of 2 per cent, payable April 15 to stock of record April 1.

The board of directors of the Western Power Corporation has declared a quarterly dividend of 1 per cent on preferred stock, payable April 15 to stock of record March 30.

Inspiration Copper Company has declared a quarterly dividend of $2.00 per share, payable April 29 to stock of record April 12.

Northern States Power Company has declared a quarterly dividend of 1¾ per cent on preferred stock, payable April 20 to stock of record March 27.

Western Power Company has declared a quarterly dividend of 1 per cent on preferred stock, payable April 15 to stock of record March 30.

Western States Gas & Electric Company has declared a quarterly dividend of 1¾ per cent on preferred stock, payable April 15 to stock of record March 30.

Ottumwa Railway & Light Company has declared a quarterly dividend of 1¾ per cent on preferred stock, payable April 15 to stock of record March 30.

Westinghouse Air Brake Company has declared a quarterly dividend of $1.75, payable April 22 to stock of record April 8.

United Railways & Electric Company of Baltimore has declared the regular quarterly dividend of 50 cents on common stock, payable April 15 to stock of record March 27.

American Telephone & Telegraph Company has declared a quarterly dividend of 2 per cent, payable April 15 to stock of record March 15.

Colorado Power Company has declared the regular quarterly dividend of ½ of 1 per cent on common stock, payable April 15 to stock of record March 30.

Monongahela Valley Traction Company has declared a dividend of 37½ cents on preferred stock, payable April 6 to stock of record March 30, also a dividend of 31¼ cents on common stock, payable April 15 to stock of record March 30.

Public Service Corporation of Northern Illinois has declared the regular quarterly dividends of 1½ per cent on preferred stock and 1¾ per cent on common stock, both payable May 1 to stock of record April 15.

Southern California Edison Company has declared the regular dividend of $1.75 on the first preferred stock, payable April 15 to stock of record March 31.

Central Illinois Public Service Company has declared a quarterly dividend of 1½ per cent on preferred stock, payable April 15 to stock of record March 30.

Earnings.

COMMONWEALTH POWER, RAILWAY & LIGHT COMPANY.

Commonwealth Power, Railway & Light Company for the month of February reports gross earnings of $1,619,201; net of $570,060, and a deficit after charges of $14,144. For the two months ended February 28, gross earnings totaled $3,319,671, net $1,077,882, and a deficit after charges of $100,530. For the twelve months ended February 28, gross earnings were $19,894,954; net $8,252,013, and surplus after charges $1,618,454.

SOUTHWESTERN POWER & LIGHT COMPANY.

The gross properties now controlled by the Southwestern Power & Light Company, inter-company charges eliminated, report for January, 1918:

Gross earnings	$ 484,887
Net earnings	194,754
Twelve months:	
Gross earnings	4,736,640
Net earnings	2,056,250

COLUMBUS GAS & ELECTRIC COMPANY.

	1918.	1917.
February gross	$1,178,033	$1,051,698
Net after taxes	612,949	577,308
Surplus after charges	425,765	376,503
12 months' gross	11,123,332	9,452,971
Net after taxes	5,338,788	4,685,398
Surplus after charges	2,977,146	1,608,179

LAKE SHORE ELECTRIC RAILWAY SYSTEM.

	1917.	1916.
December gross	$ 167,571	$ 149,815
Net after taxes	60,221	51,899
Surplus after charges	20,885	15,341
12 months' gross	1,786,011	1,618,551
Net after taxes	575,321	595,839
Surplus after charges	153,988	159,192

UTAH SECURITIES CORPORATION.

(Earnings of subsidiaries.)

	1918.	1917.
February gross	$ 580,559	$ 502,123
Net after taxes	323,869	281,482
12 months' gross	6,752,222	5,744,848
Net after taxes	3,597,945	3,176,694

CANADIAN WESTINGHOUSE COMPANY.

For the year ended December 31—

	1917.	1916.
Gross operating earnings	$1,567,199	$1,154,534
Net earnings	846,276	979,534
Less dividends	498,352	499,627
Balance	347,924	479,917
Previous surplus	1,053,692	1,303,692
Final surplus	1,401,616	2,303,492

INTERBOROUGH RAPID TRANSIT COMPANY.

For February—	
Gross operating revenue	$ 3,256,310
Net operating income	1,443,776
Gross income	1,495,300
Net income	627,676
For the eight months ended February 28—	
Gross operating revenue	$26,494,347
Net operating income	11,622,781
Gross income	11,977,131
Net income	4,888,255

CANADIAN GENERAL ELECTRIC COMPANY.

Canadian General Electric Company has issued its statement for year ended December 31, 1917, showing net profits of $1,133,596, as compared with $1,185,420 for 1916. Income account for the year compares as follows:

	1917.	1916.
Profits	$2,051,609	$2,225,912
Depreciation	524,317	408,887
Amortization reserve.	393,694	631,603
Net profit	$1,133,596	$1,185,420
Common dividends	640,000	639,843
Preferred dividends	140,000	140,000
Surplus	$ 353,596	$ 405,577
Previous surplus	612,696	707,119
Total surplus	$ 966,293	$1,112,696
Reserve	500,000	500,000
Profit and loss surplus	$ 466,293	$ 612,696

ALABAMA POWER COMPANY.

	1918.	1917.
February gross	$ 206,780	$ 147,797
Net earnings	127,420	101,329
12 months' gross	2,207,934	1,605,420
Net earnings	1,345,887	1,018,724

AMERICAN POWER & LIGHT COMPANY.

	1918.	1917.
January gross	$1,163,848	$1,030,875
Net earnings	481,694	443,321
12 months' gross	11,522,632	10,423,677
Net earnings	4,800,787	4,690,948

WISCONSIN-MINNESOTA LIGHT & POWER COMPANY.

	1918.	1917.
Gross for 12 months ending January 31.	$1,725,001	$1,328,253
Net after taxes	887,724	707,343
Surplus after charges	584,108	.....

DAYTON POWER & LIGHT COMPANY.

	February 1918.	February 1917.	2 months ended February 28, 1918.	2 months ended February 28, 1917.	12 months ended February 28, 1918.	12 months ended February 28, 1917.
Gross earnings	$193,187	$167,246	$388,664	$344,816	$1,924,466	$1,687,525
Operating expenses (including depreciation and taxes)	143,698	113,378	287,688	227,970	1,326,263	1,091,559
Net earnings	$ 49,489	$ 53,868	$100,976	$116,846	$ 598,203	$ 595,966
Non-operating revenue	1,105	687	3,737	1,054	13,016	7,253
Total income	$ 50,594	$ 54,555	$104,713	$117,900	$ 611,219	$ 603,219
Interest on bonds	$ 21,258	$ 15,204	$ 41,587	$ 30,408	$ 192,799	$ 182,459
Other deductions (includes other interest and sinking fund)	12,165	10,203	24,272	21,264	127,365	70,453
Total deductions	$ 33,423	$ 25,407	$ 65,859	$ 51,672	$ 320,164	$ 252,912
Net income	$ 17,171	$ 29,148	$ 38,854	$ 66,228	$ 291,055	$ 350,307
Dividends on preferred stock	14,813	14,813	29,625	29,625	177,750	177,750
Surplus	$ 2,358	$ 14,335	$ 9,229	$ 36,603	$ 113,305	$ 172,557
Operating ratio	74.38%	67.79%	74.02%	66.11%	68.92%	64.68%

Assets.	February 1918.	February 1917.
Property investment	$13,008,351.59	$11,003,931.63
Security investment	2,500.00	10,500.00
Construction and improvement funds	.....	1,154,533.42
Current assets	426,427.14	365,198.91
Nominal assets	71,652.00	72,546.00
Supply accounts	194,073.29	135,896.46
Unamortized discount and expense	178,098.95	103,789.23
Prepaid accounts	12,319.39	12,808.37
Suspense accounts	8,941.26	1,313.15
	$13,902,363.62	$12,860,517.17
Liabilities.		
Funded debt	$ 5,297,000.00	$ 4,899,000.00
Current liabilities	1,055,899.92	645,370.89
Accrued liabilities	198,687.77	172,307.37
Coupons and dividends matured	71,652.00	72,546.00
Reserves	745,821.96	411,600.22
Capital stock—preferred	2,962,500.00	2,962,500.00
Capital stock—common	3,053,000.00	3,053,000.00
Surplus	517,801.97	644,192.69
	$13,902,363.62	$12,860,517.17

WEEKLY COMPARISONS OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid Mar. 26.	Bid Apr. 2.
Adirondack Electric Power of Glens Falls, common	6	16	15
Adirondack Electric Power of Glens Falls, preferred	6	72	69½
American Gas & Electric of New York, common	10 +extra	89	88
American Gas & Electric of New York, preferred	6	40	40
American Light & Traction of New York, common	..	207	202
American Light & Traction of New York, preferred	6	96	95½
American Power & Light of New York, common	4	45	45
American Power & Light of New York, preferred	6	75	73
American Public Utilities of Grand Rapids, common	..	20	20
American Public Utilities of Grand Rapids, preferred	6	54	53
American Telephone & Telegraph of New York	..	100¾	100¾
American Water Works & Elec. of New York, common	..	4¾	4
American Water Works & Elec. of New York, particip	7	12	12½
American Water Works & Elec. of New York, first preferred	..	59	58¼
Appalachian Power of Bluefield, common	..	2¼	2¼
Appalachian Power of Bluefield, preferred	7	20	20
Cities Service of New York, common	+extra	203	201
Cities Service of New York, preferred	6	74½	74¾
Commonwealth Edison of Chicago	8	106	105
Comm. Power, Railway & Light of Jackson, common	..	24	23
Comm. Power, Railway & Light of Jackson, preferred	6	48½	47
Federal Light & Traction of New York, common	..	6	6
Federal Light & Traction of New York, preferred	..	28	28
Illinois Northern Utilities of Dixon	6	..	70
Middle West Utilities of Chicago, common	2+extra	25¼	24
Middle West Utilities of Chicago, preferred	6	56	56
Northern States Power of Chicago, common	ex. div. 7	60	50
Northern States Power of Chicago, preferred	ex. div. 7	87	80
Pacific Gas & Electric of San Francisco, common	..	35½	35
Pacific Gas & Electric of San Francisco, preferred	6	81½	79¾
Public Service of Northern Illinois, Chicago, common	7	74	75
Public Service of Northern Illinois, Chicago, preferred	6	85	85
Republic Railway & Light of Youngstown, common	4	22¾	24¼
Republic Railway & Light of Youngstown, preferred	6	59	59
Standard Gas & Electric of Chicago, common	..	6	4
Standard Gas & Electric of Chicago, preferred	6	24	23
Tennessee Railway, Light & Power of Chattanooga, common	..	2½	2½
Tennessee Railway, Light & Power of Chattanooga, preferred	6	8	8
United Light & Railways of Grand Rapids, common	4	29	29
United Light & Railways of Grand Rapids, preferred	6	60½	60½
Western Power of San Francisco, common	..	12½	12½
Western Power of San Francisco, preferred	6	48	48
Western Union Telegraph of New York	extra	91⅛	92
Industrials—			
Electric Storage of Philadelphia, common	4	48	47
General Electric of Schenectady	8	136½	138
National Carbon of Cleveland, preferred	8	56⅛	56
National Carbon of Cleveland, common	..	130¾	130½
Westinghouse Electric & Mfg. of Pittsburgh, common	+extra	40¼	40
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	59	59

*Last sale.